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Test Operations Procedure 1-2-610
AD No.

15 May 1990

U.S. ARMY

TEST AND EVALUATION COMMAND

HUMAN FACTORS ENGINEERING

PART I

TEST PROCEDURES

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The material in this TOP is intended to be used for the Human Factors Engineering (HFE) assessment of all types of materiel and systems tested by TECOM. Supplementary sources of guidance are indicated when required. TOP 1-2-610 encompasses the HFE procedures for the testing of design, functional performance, and environmental considerations for the major test functions (operability, maintainability, transportability, portability/usability, erectability, and habitability) applicable to the HFE assessment.

This TOP contains two parts: Part I, Test Procedures and Part II, HEDGE. Part I, Test Procedures, provides guidance on how to plan and conduct an HFE test. Part I includes specific test procedures for measurement and assessment of environmental, design, and performance characteristics of test items and sample data collection forms such as checklists, questionnaire/interview forms, and other data collection forms. Part II, the Human Factors Engineering Data Guide for Evaluation (HEDGE) provides planning guidance concerning what to test. HEDGE includes guidance on classification of the test item, identification of applicable test functions, test conditions, performance tasks, and detailed design criteria. (JS)

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DEPARTMENT OF THE ARMY
HEADQUARTERS, U.S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND 21005-5055

REPLY TO
ATTENTION OF

6 SEP 1990

AMSTE-TC-D (70-10p)

MEMORANDUM FOR Administrator, Defense Technical Information Center, ATTN: DDAC, Cameron Station, Alexandria, VA 22304-6145

SUBJECT: Test Operations Procedure (TOP) 1-2-610, Human Factors Engineering, Part I, Test Procedures, and Part II, HEDGE

1. Enclosed are DTIC Form 50 (encl 1) and two copies of subject test operations procedure (encl 2) for assignment of accession number.

2. Subject document supersedes TOP 1-2-610, 30 Nov 83, presently in your system under AD No. A140343 and 140391, which should be removed from your library.

3. Point of contact at this headquarters is Mr. Wolfgang HR. Schmidt, AMSTE-TC-D, amstetcd@apg-emh4.apg.army.mil, AUTOVON 298-3677/2170.

FOR THE COMMANDER:

2 Encls

Frederick D. Mabanta
FREDERICK D. MABANTA
Chief, Tech Dev Div
Directorate for Technology

US ARMY TEST AND EVALUATION COMMAND

TEST OPERATIONS PROCEDURE

AMSTE-RP-702-100
*Test Operations Procedure 1-2-610 May 15 1990

HUMAN FACTORS ENGINEERING

Part I. TEST PROCEDURES **Page**

*This TOP supersedes TOP 1-2-610, 30 November 1983.

Part I. Tables (Cont.) Page

Part I. Appendixes

Part II. HUMAN FACTORS ENGINEERING DATA GUIDE FOR EVALUATION (HEDGE)

1.0 SCOPE AND USE OF TOP 1-2-610

1.1 Scope The material in this TOP is intended to be used for the Human Factors Engineering (HFE) assessment of all types of materiel and systems tested by TECOM with the exception of the soldier-computer interface which is contained in TOP 1-1-059, Human Factors Evaluation of the Soldier-Computer Interface. Supplementary sources of guidance are indicated when required. It encompasses the HFE procedures for the testing of design, functional performance and environmental considerations for the major test functions (operability, maintainability, transportability, portability/usability, erectability, and habitability) applicable to the HFE assessment. This TOP contains two parts: Part I, Test Procedures and Part II, HEDGE. Part I, Test Procedures, provides guidance on how to plan and conduct an HFE test. This part also includes specific test procedures and sample data collection forms, such as checklists, questionnaire/ interview sheets and other data collection forms. Part II, the Human Factors Engineering Data Guide for Evaluation (HEDGE) provides planning guidance concerning what to test and includes guidance in the selection of applicable test functions, test conditions, performance tasks, and detailed design criteria. The scope of the HFE test during the technical test phases is specified in TECOM Suppl 1 to AR 602-1. The scope of HFE testing during customer tests will be limited to that specified by the customer.

Note: Procedures for human body vibration and toxic fumes hazards are not included in this TOP. TOP 2-2-808 addresses field shock and vibration tests of vehicles. TOP 2-2-614 addresses toxic hazards tests for vehicles and other equipment.

The material contained in this TOP does not include detailed methods for statistical analysis of data. Guidance for statistical treatment of data is contained in standard sources such as DARCOM PAMPHLET 706-103, Engineering Design Handbook-Selected Topics in Experimental Statistics with Army Applications, December, 1983.

1.2 Using TOP 1-2-610 This TOP consists of two parts as follows:

a. Part I - Test Procedures

b. Part II - Human Factors Engineering Data Guide for Evaluation (HEDGE)

It is intended that the materials provided in TOP 1-2-610 be tailored to the requirements of a particular HFE test. In particular, data collection forms provided in Appendix A of Part I, Task Checklists provided in Appendix A of HEDGE, and Design Checklists provided in Appendix B of HEDGE should be modified based on results of the test planning process.

The HFE specialist should read Sections 1-4 of TOP 1-2-610 Part 1 to gain an understanding of the HFE test process. To plan a test, carry out the steps described in Section 3.0 referring to the various Appendixes and to Part II HEDGE or to other TOPs and documents as indicated. As test requirements are defined, materials, checklists, data collection forms, etc. should be modified as necessary.

1.3 Applicable Documents The primary source of HFE design criteria which are used in HFE testing is MIL-STD-1472D, Human Engineering Design Criteria for Military Systems, Equipment and Facilities. It will be necessary to obtain a copy of MIL-STD-1472D in order to use TOP 1-2-610 because the TOP references design criteria and data contained in MIL-STD-1472D. Essentially, TOP 1-2-610 provides HFE test guidance, specific test procedures, and materials which allow the HFE specialist to identify relevant criteria and to organize the data collection effort necessary to test an item against these criteria.

It is recommended that the test activity obtain additional documentation depending on the types of HFE testing anticipated. The following documents have wide applicability to many HFE tests. Other references are applicable to specific test types and are provided in Appendix F of Part I.

MIL-STD-1472D Human Engineering Design Criteria for Military Systems, Equipment and Facilities

MIL-HDBK-759A(MI) Human Factors Engineering Design for Army Materiel (Metric) with Change Notices 1 and 2

TOP 1-1-059 Soldier-Computer Interface

AR 602-1 Human Factors Engineering Program

TECOM Regulation 70-24 Research Development and Acquisition - Documenting TECOM Testing

TOP 1-1-012 Classification of Deficiencies and Shortcomings

TECOM PAM 602-1 Questionnaire and Interview Design (Subjective Testing Techniques)

AMC Regulation 70-13 Test Incident and Related Reporting

AR 602-2 Manpower and Personnel Integration (MANPRINT) in Materiel Acquisition Processes

TECOM Regulation 70-5 Use of Soldier Operator-Maintainer Test and Evaluation (SOMTE) Personnel in Technical Testing

DARCOM PAM 706-103 Engineering Design Handbook - Selected Topics in Statistics with Army Applications

MIL-STD-12 Abbreviations for Use on Drawings, Specifications, Standards, and in Technical Documents

MIL-STD-1280 Keyboard Arrangements

MIL-STD-1801 (USAF) User/Computer Interface

TOPs are available from the Defense Technical Information Center (DTIC), Defense Logistics Agency, Cameron Station, Alexandria, VA, 22304-6145. Other TECOM documents are available from TECOM Headquarters. Federal and military specifications, standards and handbooks are available from the Naval Publications and Forms Center (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099. American National Standards Institute (ANSI) and International Standards Organization (ISO) documents can be obtained from the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018. Society for Automotive Engineers (SAE) documents can be obtained from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

2.0 FACILITIES AND INSTRUMENTATION

Specific requirements for facilities and instrumentation are included in the Specific Test Procedures (sections 5.1 through 5.20). General requirements are given below.

2.1 Facilities Facility requirements depend on the classification of the item being tested and on the test conditions. Facilities normally provided for other subtests are often adequate for the requirements of HFE testing. Any additional facilities required for HFE tests are so specified.

2.2 Instrumentation Requirements for instrumentation generated in an HFE test plan can, in most cases, be satisfied through use of the TECOM HFE Instrumentation Package. A list of package components is shown in TABLE 2-1.

Table 2-1. TECOM HFE Instrumentation Package Components

Measurement	Instrument	Specification or Standard
Noise	Sound Level Meter Band Filters	ANSI S1.4 (Type 1) ANSI S1.11 (Type E, Class II)
Illumination	Photometer	.002 to 300 Footlambert ± 4%
Force, Torque and Dimension		
Torque	Torque Gauges	
	0-80 in.-lb.	± 0.1 in.-lb.
	0-160 in.-lb.	± 1.0 in.-lb.
	0-240 in.-lb.	± 3.0 in.-lb.
	0-20 ft.-lb.	± 0.2 ft.-lb.
	0-100 ft.-lb.	± 6.4 ft.-lb.
	Torque Wrenches with 25 and 75 ft.-lb. capacities	
Force/Weight	Force Gauges	
	0-500 g.	± 0.1 g.
	0-32 oz.	± 0.25 oz.
	0-5 lb.	± 1.0 oz.
	0-20 lb.	± 0.15 lb.
	0-40 lb.	± 0.5 lb.
	0-50 lb.	± 0.5 lb.
	0-250 lb.	± 2.5 lb.
	Push-pull Gauges (2, 5, 50 and 250 lb. capacities) Accessories to include notched head, flat head, cone head, chisel head, hook and extension rod	
	Digital scale	
Dimensions and Angles	Dial Calipers	
	Tape Measures (12, 20, 100 feet)	
	Protractor	± 1.0°

Metric/English unit conversions are provided in Appendix G

Table 2-1. TECOM HFE Instrumentation Package Components (Continued)

Measurement	Instrument	Specification or Standard
Atmosphere and Environment		
Dry Bulb Temperature	Digital Thermometer	-22 to 199° F ± 0.9°F
Relative Humidity	Aspirating psychrometer	0 to 120°F ± 0.5°F
Wet Bulb Global Temperature	WBGT Heat Stress Monitor	ISO 7243
Air Velocity	Hot Wire Anemometer Wind Speed Indicator	0 to 1000 fpm. ± 3% ± 1.75 mph.
Anthropometry		
Body Dimensions	Anthropometer Sliding caliper Spreading caliper Tape Measure Anthropometric chair Goniometer	± 0.1 cm. ± 0.1 cm. ± 0.1 cm. ± 0.1 cm. ± 0.1 cm. ± 0.1 cm.
Weight	Digital scale	± 1.0 lb.
Performance		
Video Tape Recording System	Camera Recorder Monitor	
Still Photography	Polaroid camera 35mm camera	
Time and Events	Digital timer Multiple event counter Audio tape recorder	
Support Equipment	Tool kit Equipment cases Instrument tripods Binoculars NiCad battery charger Scientific calculator	

Metric/English unit conversions are provided in Appendix G

3.0 PREPARATION FOR TEST

Prior to using TOP 1-2-610 to plan an HFE test, obtain copies of the following for the test item:

a. TECOM Independent Assessment Plan (IAP), Army Materiel Systems Analysis Activity (AMSAA) Independent Evaluation Plan (IEP) or AMSAA Test Design Plan (TDP)
b. System MANPRINT Management Plan
c. Technical Manuals
d. Required Operational Capability (ROC) and/or System Specification

To get copies of these documents, contact:

a. the Test Activity Test Director
b. the HFE counterpart in the RAM/ILS/HFE Division at TECOM HQ
c. the TD&E Officer at AMSAA
d. the Test or Assessment Officer at TECOM HQ

The primary emphasis in human factors engineering testing must be placed on an assessment of the effectiveness and degree of safety with which the test item can be operated, maintained, occupied, transported, or otherwise used by qualified personnel in the designated environment. The major requirements in the preparation of an HFE test are to identify what is to be tested, how the test is to be conducted, and what criteria are to be used. The determination of what is to be tested and analyzed in an HFE test requires the identification of objectives and critical issues for testing, and the selection of test measures. In the process of determining critical issues, previous test records on the items should be studied to ascertain any human factors problems that may have arisen in earlier development testing. HFE objectives, as well as related critical issues, may be designated in the Independent Assessment Plan (IAP), Independent Evaluation Plan (IEP), Test Design Plan (TDP), or other pertinent information concerning the test item. Such background information shall be used to tailor the HFE subtest, as well as the data collection techniques, to the particular item being tested. An HFE Test Planning Checklist for ensuring that applicable steps are followed is provided in Appendix A of Part I. This checklist should be used throughout the test planning process. For some HFE tests, the HFE specialist should coordinate with other test elements to insure the availability of facilities and instrumentation or data appropriate for the HFE subtest. The specific steps to be followed in preparing an HFE test plan are described below.

3.1 Step 1 - Classify the Test Item The initial step in the planning of an HFE test is to classify the test item into one or more of the appropriate test item classes. Guidance contained in HEDGE, Part II of this TOP, is presented in terms of the following Test Item Classes and Subclasses, which are fully defined and described in HEDGE:

a. Vehicles - Maneuvering, Air, or Non-Maneuvering

b. Weapons - Individual, Crew Served, or Ammunition

c. Materiel Handlers - Soldier-Operated or Soldier-Monitored

d. Electronics/Signals - Sensors & Detectors or Information/Command-Control Systems

e. Operational Support - Maintenance & Repair Equipment, Materiel Production & Environment Control, or Major Construction Items

f. Troop Support - Consumables, Clothing & Personal Equipment, or Living & Working Areas.

3.2 Step 2 - Determine the Applicable Test Functions The test functions of concern in an HFE test, as fully defined and described in HEDGE, are listed below:

a. Operability tests are applicable in all HFE tests of Developmental and Non-Developmental Items.

b. Maintainability tests are applicable in all HFE tests of Developmental and Non-Developmental Items.

c. Portability/Usability tests are applicable in all HFE tests of Developmental and Non-Developmental Items.

d. Erectability

e. Habitability.

3.3 Step 3 - Identify Use Conditions Use conditions are factors which may influence operability, maintainability, etc. and include environmental factors such as cold/heat, day/night, etc. under which the item may be used. Use conditions, however, can also arise from mission factors or characteristics of test participants.

The HFE specialist planning a test will ensure that HFE tests are performed under conditions representative of item use to the extent that such conditions are expected to have an effect on performance in operating or maintaining tho item. HFE test criteria which involve use conditions are included in the Sample Design Checklists in Appendix B of HEDGE. Potential effects of environmental conditions on operator/maintainer performance are also given in Appendix D of Part I and effects of cold environments are provided in TOP 1-1-003. Applicable use conditions should be selected from the following lists:

3.3.1 User (Test Participant) Conditions Use conditions associated with the test participant include individual differences between personnel and clothing/equipment requirements which could affect operability/maintainability of the test item.

a. Gender (male, female)

b. Body size (height, weight, etc.)

c. Limb size (dimensions, reach distance, etc.)

d. Clothing (size, type)

e. Encumbrances (combat pack, weapon, radio)

f. Skills and knowledge (MOS, experience, training)

g. Special considerations (handedness, physical strength, wearing of eyeglasses, and facility of spoken English).

3.3.2 Environmental Conditions Use conditions associated with the environment include climate and weather under which the item will be operated and factors associated with the intended mission which could affect operability/maintainability of the test item. Expected HFE environmental effects have been identified for item tasks by Test Function and Test Item Class and Subclass. These environmental effects are presented in Appendix D of Part I. In developing a test plan for a specific item, the HFE specialist should consult the pages in Appendix D of Part I appropriate to the Test Function and Test Item Class and Subclass and identify environmental use conditions to be included in the test. Some of these are listed below:

a. Weather (rain, snow, fog and similar meteorological conditions which affect visibility and mobility)

b. Temperature (extremes of heat and cold)

c. Humidity (extremes - assessed in conjunction with temperature)

d. Climate (temperate, tropic, desert or cold regions)

e. Wind (effects on mobility, handling of components)

f. Terrain (type, evenness, hardness - effects on mobility or footing)

g. Ventilation (effects on comfort, safety and performance)

h. Airborne contaminants (dust, noxious fumes)

i. Lighting (type, location, levels - effects on visibility)

j. Noise (spectrum, loudness - effects on comfort, safety, reception of communication, performance)

k. Vibration (spectrum and intensity - effects on comfort, safety and performance).

3.3.3 Operational Conditions Operational use conditions include characteristics of the deployment and mission which could affect operability/maintainability of the test item such as :

a. Threat characteristics (type, number, distance, deployment)

b. Force characteristics (mission profile, operational mode summary, crew composition)

c. Conditions of readiness

d. Blackout conditions

e. Logistical constraints

f. Emergency conditions.

3.4 Step 4 - Identify/Analyze Operator/Maintainer Tasks One of the primary objectives of HFE testing is to verify that design characteristics of the test item are or are not adequate to support the intended use of the item. The intended use is best specified by a set of tasks which the operator/maintainer will perform. Once a set of tasks has been defined for each of the applicable test functions, Task Checklists can be used to verify that the design is adequate for performance of the task or that a human factors engineering problem exists for the task. Sample Task Checklists are included in Appendix A of HEDGE. These can be modified to represent specific tasks characteristic of the test item.

3.4.1 Task Identification and Analysis Identification of tasks to be analyzed begins with a review of the test support data package accompanying the test directive and test item. Details of Step 4 are included in section 2.4 of HEDGE. Sources of Soldier/Item Task information may include any or all of the following

a. Contractor Task Analyses

b. Generic Soldier/Item Tasks

c. Test Item Operating and Maintenance Manuals

d. Operator/Maintainer Experience

At a minimum, all high and moderate criticality tasks shall be identified as defined in section 2.4 of HEDGE. The test plan will be organized to verify suitability of design characteristics for the performance of these tasks or to detect HFE problems in task performance. All critical tasks shall be recorded on the Preliminary HFE Analysis form provided in Appendix A of Part I.

3.4.2 Criticality Analysis When the critical tasks and task sequence have been identified, an analysis shall be performed to determine:

a. Who performs the task?

b. What performance criteria apply to the task (time, rate, sequence, etc.)?

c. Are controls and displays involved?

d. What information input is required from other personnel?

e. What commands are required from other personnel?

f. Are potential errors associated with the task?

g. How the operator or HFE specialist knows that an error has occurred (feedback)?

h. What environmental conditions (both climatological and technical or equipment produced) may be expected to influence performance of the task?

i. What conditions specific to the operation will affect performance of the task (body size, clothing, skill level)?

3.4.3 Tailored Task Checklists As the sequence of tasks is identified, a specific Task Checklist appropriate to the Test Item Class and Subclass shall be completed. This involves developing an item-specific Task Checklist from the appropriate Sample Task Checklists in Appendix A of HEDGE, adding any other tasks judged to be of high and moderate criticality and deleting generic tasks found not applicable to the test item. The Task Checklist must be completed at this point in the planning process so that it can be used to identify potential problems and areas where further investigation will be required in the HFE test.

3.5 Step 5 - Conduct Preliminary HFE Analysis The HFE specialist or test planner will use any and all available information, including the technical data package, manuals and the test item itself if it is available to conduct the preliminary HFE analysis.

3.5.1 Prepare Preliminary HFE Analysis Form When the HFE specialist has identified tasks from the task checklists which should receive special consideration in the HFE test, an enumeration of these tasks shall be made on the Preliminary HFE Analysis form. A copy of this form is provided in Appendix A of Part I. For each task identified, factors to be considered in the test will be determined in terms of environmental conditions (e.g., effects of ambient noise on a communication task, or effects of illumination on an inspection task); equipment characteristics (e.g., size, shape, location, visibility, etc., of components); test participants' characteristics (e.g., limb length, clothing conditions, experience with similar items); and performance (weapon delivery, tracking, road following, decision making, etc.).

3.5.2 Walk-Throughs and Talk-Throughs Walk-Throughs and/or Talk-Throughs can be conducted by the HFE specialist if sufficient information exists about operator/maintainer tasks. Alternatively, an experienced operator/maintainer should

assist the HFE specialist. The analysis consists of considering each task in sufficient depth to identify:

a. Potential HFE problems in: equipment design characteristics, environmental effects, and system performance

b. Test participant characteristics (body dimensions, skills, clothing) to be evaluated

c. Types of tests to be included and measurements required

d. General data requirements

e. Facilities and instrumentation required.

3.6 Step 6 - Identify Design Test Criteria Item design criteria are the standard HFE criteria which specify limits of forces, dimensions, workspace, noise, visibility constraints, weights, clearances, arrangements, and operational conditions. These criteria, derived from MIL-STD-1472D and other applicable military standards and specifications, are presented in the Sample Design Checklists in Appendix B of HEDGE. Selection and development of item-specific Design Checklists is covered in detail in section 2.6 of HEDGE. The Design Checklists serve two purposes. First, they provide an index to the design criteria contained in MIL-STD-1472D. Second, they can be modified by deleting checklist items which are not applicable to the test item. The item-specific Design Checklists can then be used for data collection.

HEDGE provides a means of classifying test items as described in section 3.1. Based on this classification, the component types generally associated with the Test Item Class and Subclass are identified. There is a Sample Design Checklist in Appendix B of HEDGE for each component class. Within a particular Design Checklist, items are grouped according to HFE considerations defined in HEDGE. Where a Design Checklist item is based on requirements of MIL-STD-1472D, a reference is provided to the appropriate paragraph in MIL-STD-1472D. If a Design Checklist item is clearly not applicable to a test item, it can be deleted from the item-specific Design Checklist. The referenced paragraph in MIL-STD-1472D should be consulted to determine applicability and to obtain detailed information on which to base a decision on design adequacy of the test item.

3.6.1 Determine the Applicable Test Item Components The HFE subtest shall include procedures for the test and analysis of the HFE design, technical and performance characteristics of the system. To determine the specific characteristics applicable to the system being tested, the HFE specialist must identify the Test Item Components with which the operator/maintainer interacts in performing the specified tasks. This identification is made by using section 2.6 of HEDGE.

3.6.2 Tailored Design Checklists The HFE specialist must select those Design Checklists and design criteria which apply to the selected Test Item Components. The Design Checklists for the test item will then be developed based on the generic Design Checklists contained in Appendix B of HEDGE.

3.7 Step 7 - Select Test Procedures The selection of test procedures depends in large part on the type of test and the item being tested. There are two general categories of HFE tests: design tests and performance tests. Both categories of tests must be used by the HFE specialist in planning the HFE subtest. (1) Design tests are directed toward measuring and assessing the HFE technical and design characteristics of the item. (2) Performance tests are concerned with determining the adequacy of the soldier-machine interface and the performance capability of the operator/maintainer when using the item. The selection of specific tests within each of the two general categories depends on the type and complexity of the item or system being tested.

3.7.1 Equipment Technical and Design Characteristics Technical characteristics include the mechanical, thermal, atmospheric or illumination environments created by the item during use, and the environmental conditions under which the item must be operated and maintained (weather, climate, temperature, noise, terrain, illumination, etc.). Technical characteristics are assessed using specific Test Procedures which are described in sections 5.1 through 5.3.

Design characteristics include the physical dimensions of the item components which are used by or which contact the item operator/maintainer. These components include controls, displays, steps and ladders, labels, communications equipment, doors, fasteners, handles, optics, workspace, seats, tools, and any other elements of the item which are handled, controlled, adjusted, avoided, moved, read, communicated or contacted by personnel during item use. Design characteristics are assessed using specific Test Procedures which are described in sections 5.4 through 5.7. HFE Design Checklists (section 5.8) will be used to assess the adequacy of both the technical and design aspects of the equipment.

3.7.2 System Performance Tests and Analysis Performance can either be directly measured or inferred. If inferred, it can be described either analytically or by test participants. Direct measurements of performance producing quantitative, objective measures of system (soldier-machine) performance capability should be used. Measurements should be identified from the task analysis, specifically the performance standards. Where the standards require a specified rate of fire, or first round accuracy, or time to troubleshoot a component, or some similar specified level of performance, a direct measurement performance test is indicated. These data may be obtained from tests conducted for other subtests such as RAM or safety. To supplement direct measurements, and to provide data where direct measurements are not possible, performance analyses are conducted. The objective of these analyses is to identify system performance problems. The analyses may be conducted by the HFE specialist or they may be based on information received from personnel after a period of operating or maintaining the item. Examples of performance analyses include error likelihood analysis, workload analysis, team interaction analysis and training effectiveness analysis. The specific methods for conducting these analyses are presented in sections 5.9 through 5.20. Performance problems may be identified by the HFE specialist through the use of Test Procedure 17 described in section 5.17 and the Sample Task Checklists provided in Appendix A of HEDGE. Special cold regions problems are addressed in sections 5.19 and 5.20.

3.8 Step 8 - Develop Questionnaires and Interviews Valid and reliable data reflecting personnel opinions and insights concerning soldier-item system performance capability, military utility and soldier acceptance shall be obtained through the use of carefully prepared and administered questionnaires and interviews. These methods are employed to obtain opinions, attitudes and preferences of personnel who have "hands-on" experience with the equipment. They serve also to supplement and clarify information derived from observations and measurements concerning identification of use problems, magnitude of problems, causal factors, and test participant perceptions of implications and effects of such problems. Guidance in the preparation of questionnaires and interviews is given in section 5.18 and sample questionnaire and interview materials are contained in Appendix B of Part I. Additional detailed guidance in the preparation of questionnaires and interviews is also provided in TECOM PAM 602-1.

3.9 Step 9 - Identify Test Participants The sample of test participants used shall be representative of the user population in terms of MOS, skill level, and training. Test project personnel, therefore, shall review the item documentation to determine the following characteristics of the intended user population. In addition, any specific

training programs necessary to operate, maintain, or otherwise use the item must be identified.

Although the names of test participants should not be used in test reports, each participant should be identified by a code. This code needs to be consistent between the various HFE procedures and data forms (i.e. questionnaire/interview responses and comments, demographics, anthropometry, tasks checklists, speech intelligibility, etc.). If soldier, operator, maintainer, test and evaluation (SOMTE) personnel are used as test participants, their sequence numbers from the SOMTE electronic data base should be used as the code. (See TECOM Regulation 70-5 for a description of the data base.) If test schedule and review committee (TSARC) soldiers or DA civilians are used, any consistent code will suffice.

The information listed below represents sample criteria for subject selection. The distribution of each characteristic in the test participant sample shall be similar to that of the population distribution within selection constraints. The characteristics to be determined and recorded for all participants shall include consideration of the following:

a. Gender The representation of male and female in the test sample should be similar to that of the intended user population.

b. Physical Dimensions Ranges of heights and weights shall be specified, giving due consideration to the range of these dimensions expected of typical user personnel when the system is fielded. Specifically, the range should encompass the 5th through 95th percentile as described in TABLE 2-10 in MIL-HDBK-759A(MI). Determination must be made of specific body dimensions of importance for item use (reach, seated height, kneeling, etc.) and the 5th through 95th percentile values of these dimensions should be used (FIGURE 29 and TABLE XIX in MIL-STD-1472D). No person with a special-duty or limited duty profile can be permitted to participate unless a task analysis reveals that the restriction on his activities has no impact on the tasks required in the test.

c. Sensory Acuity All test participants should have had a recent (within the last 12 months) test of vision and audition. If vision or audition are critical to the test functions, the appropriate test shall be given both immediately before and after test operations. Minimum standards should be stated for each of these sensory modalities depending upon an analysis of the requirements of the tasks to be performed. The inclusion of participants who wear glasses should be considered if appropriate to the particular test.

d. MOS The required MOS will normally be specified in the IAP, IEP, TDP, or other test directive. If it is not, a determination must be made of the MOS and whether the specified MOS must be the test participant's primary MOS or whether a soldier with this specialty in a MOS is acceptable. If alternate specialties include the required training and are acceptable substitutes, these are to be listed in the IAP, IEP, or TDP.

e. Grade Test participants should represent the grades and skill levels specified for test item users or as specified in the Requirements Document.

f. Item Specific Training If training is required for use of the test item, this training shall be provided to test participants prior to data collection.

3.10 Step 10 - Identify Test Facility and Instrumentation Requirements The identification of facilities and test instrumentation needed shall be made for each Test Procedure described in sections 5.1 - 5.20 in accordance with the test measures to be applied to each procedure.

3.11 Step 11 - Identify Test Controls The test controls appropriate to the particular test item must be applied. The following controls are noted because of their special significance for HFE testing.

3.11.1 Control of Test Participants Selection of personnel to serve as operators and maintainers, based on characteristics identified in Step 9 (section3.9), serves to counteract personnel biases and differences in experience, motivation, and skills.

3.11.2 Control of Procedures Operators and maintainers are to perform according to standard procedures, as indicated in the appropriate technical manuals or operator and maintenance instructions accompanying the test item. This ensures more valid inferences from test results with regard to representative participants.

3.11.3 Controls for Comparison of Competitive Systems When comparing competitive items, personnel operating the competitive items should have comparable training (i.e., personnel should be cross-trained on the items being compared). To minimize the effects of variability (soldier and machine) due to performing over a period of time, whenever possible conduct the comparison tests in the same time frame under the same environmental conditions. To further minimize the influence of such sources of variability, if possible, repeat the test procedure switching the person (or crew) from item A to item B as discussed in section 3.11.4.

3.11.4 Control of Assignment of Test Participants to Test Conditions Certain HFE test procedures involve operator/maintainer performance of tasks required by the test item. In these cases, test participant performance is measured in terms of task completion time, number of errors, or other variables which characterize operator or system performance. Often such performance tests and measures are applied to competing systems or alternate designs to determine the relative effectiveness of these from the HFE standpoint. These performance oriented tests sometimes involve more than one Test Condition defined by multiple test items, variants of a test item, or a single test item which needs to be tested under different use conditions. Competing systems such as two trucks might be tested to determine which better meets Army requirements. Variants of a test item might arise if a target acquisition system could be procured and operated using digital terrain data or using operator inputs from maps. Items are often tested under multiple levels of use conditions such as day/night, temperate/arctic, etc. In general, multiple test conditions arise whenever the same tests must be replicated to provide comparative data on competing test items, on test item variants, or on effects of use conditions on test item operability/maintainability.

Multiple test conditions will be denoted as A, B, C, etc. If two competing items were to be tested, they might be called item A and item B. If three types of handwear were to be evaluated in terms of restrictions on hand/finger dexterity, there might be four test conditions - gloves A, B and C and a control condition D in which participants do not wear gloves. If a mobile antenna were to be assembled by a crew under both temperate and arctic use conditions then temperate might be called condition A and arctic condition B. The essential feature is that the same tests and measurements will be applied to test conditions A, B, ... etc. to obtain data which will allow comparative evaluation of the conditions. Clearly, it is important that the tests be unbiased. Differences in test

participant performance under the various conditions should be a function only of properties of the conditions and not due to extraneous factors introduced during the test. Where measures of test participant performance will be used as evaluation criteria, two potential extraneous factors to guard against are individual differences in skill between test participants (or crews) and changes in skill over time due to learning and practice.

The term individual differences refers to the fact that on any task certain persons will perform better than others. This may be due to differences in sensory acuity, strength, memory capacity, experience on similar tasks or whatever. The goal should be to control this source of variability in performance so that it does not bias the test results. Whenever the data for item A arise from one group of test participants and the data for item B arise from another group, apparent differences in performance between items A and B could actually be due to differences in skill between the groups and the test would be biased. Whenever possible, the same group of test participants should be used in each test condition. In the hypothetical test of handwear discussed above, the same group of test participants should perform dexterity tests under all four conditions. If one sub-group uses gloves A, another sub-group uses gloves B and so forth, it is possible to get spuriously high scores for one test item because the participants assigned to that item happened to be better at the dexterity task than were the other participant groups. This is particularly true where the sub-group sizes are small. The preferred approach in which all participants are used under all test conditions is sometimes called the within-subjects method because comparisons of results are made <u>within</u> participants. Differences in performance associated with test conditions are calculated by comparing a participant's performance in one condition with his/her performance under another condition. In theory, this provides control for individual differences and it is said that "each participant serves as his/her own control".

There are cases where the within-subject approach cannot be used. If the test project has only ten targets available and these are acquired by a group of operators using target acquisition system A then having the same group acquire the targets again using system B will bias the results in favor of B since the crew members will know the target locations. If the hypothetical mobile antenna is erected at a test center under temperate climate conditions and is then shipped to the Cold Regions Test Center for use under arctic conditions, it may be impossible to also transfer the test participants. Whenever possible, however, the within-subjects approach should be used in which each test participant serves under each test condition.

3.11.5 Control of Order of Presentation of Test Conditions Given that all test participants are to serve under each test condition, biases due to the order of presentation will need to be controlled because of learning and practice effects. Since each test participant will perform tasks under each test condition, the conditions will have to be presented in some order such as A first, B second and C third. The problem here is that participants performance will probably improve over the course of the test because of practice as the tasks are repeated. In the case above if performance under condition C were better than under B and better under B than A, there would be no way to tell if this is due to true differences attributable to the conditions or due to learning on the part of the participants. The solution is to <u>counter-balance</u> the order of presentation by varying this from one participant to another. This can be done by randomly assigning participants to groups where there are as many groups as there are test conditions. If four conditions are to be tested and twenty participants are available then groups of five would be used.

Some counter-balanced orders of presentation of two, three, and four test conditions are shown in FIGURE 3-1. Participant groups of five are shown in FIGURE 3-1 but this could be any number depending on the number of conditions and the number of test

participants. Trial blocks in FIGURE 3-1 refer to sets of test trials under a given test condition. The number of trials in a block might be one if only one performance using a test item is required of each participant. If each participant is to perform the test tasks three times under each condition to increase the numbe. of data points, then each block will contain three trials.

a. Two Test Conditions - A, B

Group	Participants	Trial Block 1	Trial Block 2
1	1 - 5	A	B
2	6 - 10	B	A

b. Three Test Conditions - A, B, C

Group	Participants	Trial Block 1	Trial Block 2	Trial Block 3
1	1 - 5	A	B	C
2	6 - 10	B	C	A
3	11 - 15	C	A	B

c. Three Test Conditions - A, B, C

Group	Participants	Trial Block 1	Trial Block 2	Trial Block 3
1	1 - 5	B	A	C
2	6 - 10	A	C	B
3	11 - 15	C	B	A

d. Four Test Conditions - A, B, C, D

Group	Participants	Trial Block 1	Trial Block 2	Trial Block 3	Trial Block 4
1	1 - 5	A	B	C	D
2	6 - 10	B	C	D	A
3	11 - 15	C	D	A	B
4	16 - 20	D	A	B	C

e. Four Test Conditions - A, B, C, D

Group	Participants	Trial Block 1	Trial Block 2	Trial Block 3	Trial Block 4
1	1 - 5	B	A	C	D
2	6 - 10	C	D	B	A
3	11 - 15	A	C	D	B
4	16 - 20	D	B	A	C

Figure 3-1. Recommended Orders of Presentation of Test Conditions

In section a. of FIGURE 3-1, two test conditions A and B are shown. Ten participants are used in the test and are assigned at random to groups (1-2) and participant numbers (1-10). If a weapon is to be emplaced while wearing arctic mittens under condition A and without arctic mittens under condition B, then group 1 (participants 1-5) will set up the weapon first while wearing mittens and will then set it up again while not wearing mittens. Group 2 (participants 6-10) will set up the weapon first without mittens and then with mittens. Conditions A and B will have received an equal number of trials by each test participant and under each trial block (1 and 2). In principle, individual differences between participants will cancel out and effects of practice which are associated with trial blocks 1 and 2 will cancel out of comparisons between the two conditions. In conducting the test in the order shown in section a of FIGURE 3-1, all participants should practice the weapon emplacement tasks without mittens before data are collected. It is sometimes suggested that sufficient practice should be given before data collection begins that performance has improved due to practice as much as it is going to. The learning curve will then be at an asymptotic value or "participants will be at the top of the learning curve". Unfortunately, human performance on skilled tasks generally continues to show marginal improvement after months of daily practice and thousands of trials. The preferred approach is to provide as many practice trials as project resources will permit and then use a counter-balanced order of presentation of conditions as shown in FIGURE 3-1.

Some counter-balanced orders of presentation are shown in FIGURE 3-1 for three and four test conditions. If there are more than four conditions, construct a schedule for the order of presentation by following the pattern in sections b and d in FIGURE 3-1. The arrangements of orders of presentation in FIGURE 3-1 are called latin squares. Each condition appears once and only once in each row and in each column. If any two rows or any two columns of a latin square are interchanged, the result is still a latin square. Sections c and e in FIGURE 3-1 are random rearrangements of sections b and d.

3.12 Step 12 - Develop Test Plan

3.12.1 Preparation of Detailed Test Plan The HFE subtest plan shall be written in accordance with TECOM Reg 70-24. The subtest plan shall follow the following format:

a. Objective This shall be a concise statement of the objective or issue to be addressed in the subtest, including the subtest's relationship with the overall test objectives.

b. Criteria This shall be a statement of the criteria contained in or referred to in the IAP, IEP, TDP, or TECOM directive. The sources of all criteria should be clearly identified down to the paragraph number.

c. Data Required This shall be a statement that details the specific data to be obtained during the test. This shall specify the accuracy requirements of the data and the numbers of samples or observations.

d. Data Acquisition Procedure This shall detail the procedures to be used in collecting the data. The TOP procedure should be referenced along with a brief description of the procedure. If the procedure deviates from a TOP or in the absence of a TOP, the procedure shall be described in detail.

e. Technical Assessment This shall describe how the data listed in the data required section will be reduced and analyzed, and how comparison against the criterion statements will be made.

3.12.2 Review of Test Plans Following preparation of the HFE portions of the Detailed Test Plan, the test project personnel shall review these plans to ensure that factors which could reduce the validity and reliability of the results have been eliminated. In particular, the test conditions to be employed and the test design are to be reviewed to determine if the planned test will provide unbiased data. Questions concerning impact of the test design on data validity should be referred to the RAM/ILS/HFE Division, Headquarters TECOM.

4.0 DATA REQUIREMENTS AND ANALYSIS

4.1 Data Required Data to be acquired in an HFE subtest include the data that are general to all types of tests and the data that are specific to the Design and Performance tests.

4.1.1 Data General to All Types of Tests

a. Demographic data on test participants

b. Descriptions of test conditions and controls (temperature, terrain, weather conditions, day/night, operation location, ice-snow conditions, visibility conditions)

c. Description of the test design, run schedule, and test conditions for each run

d. Descriptions of instrumentation used: name, type, serial number, and manufacturer

e. Descriptions of facilities and materiels used

f. Description of modifications made to instrumentation for operation in cold regions.

4.1.2 Data Specific to Design Tests Design test data are based on technical and design characteristics.

4.1.2.1 Design Tests Based on Technical Characteristics

a. Lighting data

b. Noise data

c. Temperature, humidity, and ventilation data.

4.1.2.2 Design Tests Based on Equipment Characteristics

a. Visibility data

b. Speech intelligibility scores

c. Work space evaluation data

d. Force/torque measurements

e. Completed design checklists (equipment dimensions, workspace, access, controls, displays, etc.)

f. Dexterity scores.

4.1.3 Data Specific to Performance Tests Performance Test data are based on HFE specialist analysis, direct measurement, and problem identification.

4.1.3.1 Performance Tests Based on Analysis by the HFE Specialist

a. Error likelihood estimates

b. Workload assessment

c. Team interaction assessment

d. New Equipment Training (NET) effectiveness assessment.

4.13.2 Performance Tests Based on Direct Measurements

a. Recorded times, rates, accuracies, etc.

b. Recorded error rates - from error reports

c. Recorded frequencies and durations of occurrence

d. Recorded consumption or quantity used

e. Recorded results of interviews/questionnaires, checklists.

4.1.3.3 Performance Tests Based on Problem Identification

a. Item user reported problems

b. Completed task checklists

c. Problem identified in HFE analysis.

4.2 Data Reduction and Presentation The degree to which the test item and its associated maintenance and training package conforms or does not conform to human factors engineering specifications, standards, and requirements should be presented in narrative form. Instances of nonconformance should be supported by relevant measurements and photographic illustrations.

4.2.1 Design Shortcomings and Deficiencies The causes and consequences of nonconformance shall be analyzed with regard to effect on systems and mission performance and defined in accordance with TOP 1-1-012 as a deficiency, shortcoming, or suggested improvement. Test incident reports (TIRs) should be completed in accordance with AMC Regulation 70-13. All quantitative measurement data (e.g., anthropometric, noise, illumination, temperature, etc.) shall be presented in tabular or graphic form for direct comparison with the specified criteria and to show the degree of compliance or noncompliance. The results of observation checklists and questionnaires/interviews shall be summarized and presented in tabular form. When adequate samples are available, the results should be submitted to statistical analyses. Any degradation of the effectiveness of the soldier-item relationship with regard to operation, maintenance, transport, or military utility of the system shall be assessed and corrective action recommended.

4.2.2 Statistical Analysis Where multiple measurements are taken of a particular test item characteristic because the measurements are subject to random fluctuation, appropriate descriptive statistics shall be calculated from these data. Applicable statistics include measures of central tendency including the mean, median and mode and measures of variability including the standard deviation and interquartile range. Frequency distribution analysis includes tabulation of raw frequency data, conversion to proportions or percent values and graphing using bar charts.

The material contained in this TOP does not include detailed methods for statistical analysis of data. Guidance for statistical treatment of data is contained in standard sources such as DARCOM PAMPHLET 706-103, Engineering Design Handbook-Selected Topics in Experimental Statistics with Army Applications, December, 1983.

5.0 SPECIFIC TEST PROCEDURES The specific HFE test procedures described in this TOP are presented in sections 5.1 through 5.20.

5.1 TEST PROCEDURE - LIGHTING

5.1.1 Objective The purpose of this procedure is to present test methods and measures for assessment of workspace lighting. The procedure is primarily intended for internal enclosures but can be extended to external work sites to the degree that requirements for external lighting are consistent with those defined for internal illumination.

5.1.2 Criteria The criteria for establishing whether sufficient illumination is present shall be those contained in TABLE XXI in MIL-STD-1472D for different work areas and types of tasks except for blackout or special low-level lighting requirements. The criteria for assessing display lighting are presented in TABLE XXII in MIL-STD-1472D.

5.1.2.1 Direct Glare Glare control methods assume the operator is using unaided vision. Eyeglasses reflect glare into the eyes if a bright light behind the viewer is between 30 degrees above and 45 degrees below the line of sight, or if it is within 20 degrees left or right of the line of sight.

5.1.2.2 Reflected Glare Reflected glare from work surfaces is a common, but frequently overlooked cause of reduced performance in visual tasks. FIGURE 3.7 in MIL-HDBK-759A(MI) gives acceptable ranges of reflectance values for different surfaces.

5.1.2.3 Indicator Light Coding The coding of simple indicator lights shall be that presented in TABLE II in in MIL-STD-1472D and the criteria for group viewing of optical projection displays shall be those in TABLE IV in MIL-STD-1472D.

5.1.2.4 Transilluminated Display Brightness The brightness of transilluminated displays shall be 10% greater than the surrounding surface but never more than 300% of the surrounding surface. The brightness contrast of the figure-ground relationship shall be at least 50%.

5.1.2.5 CRT Brightness The brightness of the surface around a CRT shall be from 10% to 100% of that of the CRT. None of the surface surrounding the CRT shall exceed it in brightness with the exception of warning lights.

5.1.2.6 Aircrew Station Signals Lighting used in aircraft should also conform to the criteria contained in MIL-STD-411, MIL-L-5667 and MIL-L-25467.

5.1.3 Facilities and Instrumentation

5.1.3.1 Facilities None.

5.1.3.2 Instrumentation Photometers, as described in Table 2-1, are used for illumination measurements. The photometer should be capable of measuring both illuminance (in foot-candles or lux) produced by light arriving at a surface and luminance or brightness (in foot-lamberts or candela per square centimeter) emitted by an extended source or reflected by a surface.

5.1.4 **Method** This test will not require use of representative test participants. The conduct of the test will have the HFE specialist acquire illumination levels falling on selected workspace areas, and brightness values of displays, and perform a comparison of obtained light values with criteria denoting the minimum allowable levels.

5.1.4.1 General Guidelines For efficient performance of the various tasks which crews must perform, certain minimum amounts of light are required. Among the duties of a vehicle crew, map reading undoubtedly requires the highest level of illumination. The amount of light necessary for gross tasks such as the location and identification of stowage items is generally the lowest level required.

For a given task the illumination required varies with conditions inside and outside the shelter or fighting compartment. In the daytime, for example, crew members are required to look out through the periscopes or other visual devices to drive the vehicle, spot the enemy, sight targets, etc. Alternatively, they must manipulate controls, load weapons, clear machine guns, read maps and perform other tasks inside the fighting compartment. Thus, the crew members' eyes are exposed alternately to outside and inside light levels, which at times may differ over a wide range. When this difference in intensity is great, glare results from exposure to the higher illumination and time is required for the eyes to become adjusted to the lower light levels inside the fighting compartment. During this adjustment, visual efficiency is greatly reduced, with a corresponding reduction in ability to perform the task at hand. As noted above, this glare problem becomes severe in the cold region environment where sunlight reflects from snow- or ice-covered terrain.

The illumination of outside objects may not be controllable; the inside illumination of a compartment is, and must be sufficiently bright to permit performance of all of the necessary duties within the compartment, but dim enough so as not to interfere with dark adaptation during night operations. A single white light bright enough for map reading and other necessary duties may interfere with dark adaptation; and if dimmed to where it will not interfere with dark adaptation, it may not be sufficiently bright for the performance of required duties. Therefore, the location, type, and intensity of light source is important to the successful completion of a mission.

One of the most serious of all illumination problems is glare or dazzle - relative bright light shining into the observer's eyes as he/she tries to observe a relatively dim visual field. Glare not only reduces visibility for objects in the field of view, but also causes visual discomfort.

Direct glare arises from a light source within the visual work field. It should be controlled by:

a. Avoiding bright light sources within 60 degrees of the visual field. Since most visual work is at or below the eye's horizontal position, placing light sources high above the work area minimizes direct glare.

b. Using indirect lighting.

c. Using more relatively dim light sources, rather than a few very bright ones.

d. Using polarized light, shields, hoods, or visors to block the glare in confined areas.

Reflected glare refers to reflections from bright surfaces in the visual field. It should be controlled by:

a. Using surfaces that diffuse incident light rather than reflect it without diffusion.

b. Arranging direct light sources so their angle of incidence to the visual work area is not the same as the operator's viewing angle.

Other critical issues for lighting are as follows:

a. Luminance contrast of labeling, legend lights, indicator lights, and CRT characters.

b. Lighting uniformity within displays and balance across groups of displays.

c. Trim range from minimum to maximum brightness of display lighting.

d. Readability of displays in full sunlight.

5.1.4.2 Test Conduct The HFE specialist will identify all areas on work stations within a test item where lighting could be a problem. Alternate light sources will be identified for assessment (i.e., panel lighting, map light, dome light, general area lighting, etc.). Potential glare problems in areas where the test participant is subjected to high levels of direct or reflected light will also be identified.

5.1.4.2.1 Ambient Illumination (Illuminance) The HFE specialist will measure light levels using a photometer, at areas identified in the test plan, under conditions of maximum and minimum illumination for cases where the light intensity is controllable. For all lighting tests, the ambient illumination should be measured and reported. For work benches and consoles several readings should be made in approximately one foot increments in a grid pattern over the surface to be evaluated. The illumination readings shall be recorded on a data sheet reflecting the same grid pattern. Readings shall be performed in low and daylight conditions of ambient light.

5.1.4.2.2 Display Brightness (Luminance) To measure the brightness levels of displays a spot brightness meter or spot photometer shall be used. Several areas within each display should be measured to identify hot spots or areas of nonuniform luminance. Display lighting will be assessed for lighting uniformity, lighting balance, trim range and sunlight readability.

Lighting uniformity and balance will be assessed by measuring the brightness (in foot-lamberts) at six equally spaced points around each display surface. The spot brightness photometer will be used for this measurement.

Trim range will be assessed by measuring the maximum brightness of each display to ensure visibility in the brightest expected ambient environment. The decrease in illumination as the dimming control is operated will be assessed for smoothness and evenness. The minimum brightness will be assessed to ensure that the display will be visible under all expected use conditions.

Readability of displays in direct sunlight will be assessed by observing the brightness contrast and hue contrast of displays under all expected use conditions. Luminance contrast measurements are used to determine brightness contrast (see paragraph 5.1.4.2.4).

5.1.4.2.3 Reflectance Reflectance should be measured on all control panel surfaces, work station surfaces, and other surfaces where reflected light may cause discomfort or interfere with visibility. Reflectance is a function of the amount of light reflected from a surface given the amount of light falling on the surface. Therefore, measurements of both ambient illumination (illuminance) and luminance must be made at each measurement point. Measurement points should be established in a grid pattern along the surface. The size of the grid will depend on the surface area; larger areas should have a grid of one-foot or two-foot increments. Measurements should be taken under all potential lighting conditions. Luminance measurements should be taken with the spot photometer "looking" perpendicular to the surface, with the distance from the surface dependent on the field of view of the probe. Illuminance measurements should be taken with the photometer probe mounted flat on the surface. The measurements will be substituted in the following formula:

$$\text{Reflectance} = \frac{\text{Luminance (foot-lamberts)}}{\text{Ambient Illumination (foot-candles)}} \times 100$$

5.1.4.2.4 Luminance Contrast Luminance contrast measurements will be taken with a spot brightness photometer. The photometer will be placed so that the target fills at least half of the viewing reticle and a measurement in foot-lamberts or candela per sq. cm. taken. The photometer will then be positioned so that the reticle is filled by the background and another measurement taken. This procedure will be repeated several times to compensate for any fluctuations in brightness and the measurements averaged. For large surface areas such as CRT screens, several areas should sampled. Each pair of target and background luminance measurements should be substituted into the following formula:

$$\text{Contrast} = \frac{\text{Higher Luminance - Lower Luminance}}{\text{Lower Luminance}} \times 100$$

Since the numerator and denominator are both in luminance units it makes no difference what units are used. Both numerator and denominator must be in the same units (foot-lamberts or candela per sq. cm.).

5.1.5 Data Required The test measures will involve illumination values of light falling on a surface or area (in foot-candles), and the brightness levels of illuminated displays (in foot-lamberts). Each measurement should be repeated three times and the results averaged. Where reflectance or contrast values are required, illumination and/or brightness values are substituted in the above formulas.

5.1.6 Data Reduction and Presentation The analysis of data in this procedure will be directed at identifying areas where either sufficient light is not available, or where too much light (glare) is present. Data presentation will be in the form of line drawings of panels, consoles or work areas with brightness data indicated for locations of light measurements. Specific data points, such as CRT brightness, will be presented by means of tables.

Ambient illumination at workspaces, panel or workspace reflectance, display brightness and target/background contrast values obtained from the test will be compared with appropriate criteria from MIL-STD-1472D, MIL-HDBK759A(MI), MIL-STD-411, MIL-L-5667, and MIL-L-25467 as described in paragraph 5.1.2. Measured values which do not meet these criteria will be noted.

5.2 TEST PROCEDURE - NOISE MEASUREMENT

5.2.1 Objective The purpose of this test procedure is to provide HFE subtest planning personnel with a description of methods, criteria, and instrumentation required in the assessment of noise. The test and analysis of noise will be made to determine if noise levels produced by an item under test, or by components of that item, present hazards to personnel and/or if they meet aural non-detectability criteria, speech intelligibility considerations or contribute to community annoyance. Noise assessment is performed to determine the effectiveness of noise prevention and protection devices. The types of noise tests to be performed for each class of test item are listed in TABLE 5.2-1. Citeria and methods for sound level measurements are also described in MIL-STD-1474B(MI) and in TOP 1-2-608. Additional documentation for specific noise test types is listed in Appendix F of Part I.

Table 5.2-1. Noise Tests to be Conducted

NOISE TESTS MIL-STD-1474 Test Requirements HEDGE Test Item Classes and Subclasses	Steady State Noise Personnel Occupied Areas	Aural Non-Detectability	Exterior Acceleration and Drive-By Noise	Impulse Noise
I. VEHICLES				
A. Maneuvering	•	•	•	•
B. Air	•	•	•	•
C. Non-Maneuvering	•			
II. WEAPONS				
A. Individual				•
B. Crew-Served	•			•
C. Ammunition				
III. MATERIEL HANDLERS				
A. Soldier-Operated	•		•	
B. Soldier-Monitored	•			
IV. ELECTRONICS/SIGNALS				
A. Sensors	•			
B. Information/Command-Control Systems	•			
V. OPERATIONAL SUPPORT				
A. Maintenance & Repair Equipment	•			•
B. Materiel Prod. & Environmental Control	•			•
C Major Construction Items	•			
VI. TROOP SUPPORT EQUIPMENT				
A. Consumables				
B. Clothing		•		
C. Personal Equipment		•		
D. Living & Working Areas	•			

5.2.2 Criteria The types of noise of concern in this procedure include steady-state and impulse noise. Criteria for acceptable noise levels and for the identification of hearing protection requirements are contained in MIL-STD-1474B(MI). Additional criteria which are applicable to aircraft are provided in MIL-A-8806, MIL-S-008806, and MIL-STD-1294. Criteria for shipboard equipment are provided in MIL-STD-740-1.

5.2.2.1 Steady-State Noise Steady-state noise is a periodic or random variation in atmospheric pressure at audible frequencies. The duration of the variation exceeds one second and it may be intermittent or continuous.

Steady-state noise definitions and measurement procedures are provided in MIL-STD-1474B(MI). Steady-state noise shall be within limits for categories of personnel-occupied areas as specified in Tables 1 and 2 of MIL-STD-1474B(MI). Steady-state noise limits for aircraft are specified in MIL-A-8006.

5.2.2.2 Impulse Noise Impulse noise is a short burst of acoustic energy consisting of either a single impulse or a series of impulses. The pressure time history of a single impulse includes a rapid rise to a peak pressure, followed by somewhat slower decay of the pressure envelope to ambient pressure, both occurring within one second. A series of impulses may last longer than one second.

Impulse noise definitions and measurement procedures are provided in MIL-STD-1474B(MI). Impulse noise shall not exceed the limits for peak pressure level, A-duration and B-duration specified in MIL-STD-1474B(MI) or with special requirements established for the system under test.

5.2.3 Facilities and Instrumentation

5.2.3.1 Facilities

5.2.3.1.1 Stationary Operation Tests

a. For movable test items: Select an open area of uniform grade that is free of all sound-reflecting surfaces (such as buildings, trees, hillsides, or signboards) and interfering sound sources within 30.5 meters (100 ft.) of the test item and sound measuring instrumentation. The terrain surface must be either paved or stone, hard dirt, or other material having similar acoustic characteristics.

b. For test items permanently mounted: Test the item on site and state the conditions of the test report.

c. MIL-STD-1474B(MI) states that when practical, the background noise level, including wind noise, shall be at least 10 dB below that of the equipment noise being measured, but shall always be at least 10 dB below the criteria. (There is an exception for aural non-detectability. See 5.2.4.6)

5.2.3.1.2 Interior Noise Tests The following courses are required:

a. Vehicle course: A smooth, straight, paved road that is level and free of all loose gravel or other foreign matter; long enough to allow the vehicle to accelerate to two-thirds of the maximum rated engine speed or two-thirds of the posted vehicle speed in all forward gears and to maintain that speed for at least 30 seconds: and free of all sound reflecting surfaces for a distance of 100 ft. (30.5 meters) on each side. For tracked vehicles without rubber pads, a similar course

of compact earth having a cone index in the range of 100 to 150 is required unless otherwise specified.

b. Watercraft course: A body of water of sufficient area and smoothness to permit normal operation and maneuvering of the craft at maximum operational speeds. For pass-by tests, the area must be free of large obstructions (large piers, breakers, etc.) for a minimum of 100 ft. (30.5 meters) from the course the craft is to follow. Place three marker buoys in a straight line 50 ft. (15.2 meters) apart to mark the course.

c. Rotary Wing Aircraft Course: Rotary wing aircraft should be tested using the criteria and guidance in MIL-STD-1294.

5.2.3.1.3 Exterior Noise Tests These tests require a smooth, straight, paved road that is level and free of all loose gravel or other foreign matter; at least 200 ft. (61 meters) in length; and free of all sound-reflecting surfaces for 100 ft. (30.5 meters) on each side. For tracked vehicles without rubber pads, a similar course of compact earth having a cone index in the range of 100 to 150 is required unless otherwise specified.

5.2.3.1.4 Aural Non-detectability Tests For these tests select an open area of uniform grade; with a uniform, flat, grass surface free of tall vegetation, snow, or other sound absorbing materials; and free of sound-reflecting surfaces for a radius at least 260 ft. (80 meters) from the center of the area. For stationary tests of extremely low-noise-level items, use an anechoic chamber.

5.2.3.1.5 Speech Intelligibility Tests When possible, use the natural environment of the test item (i.e., its normal position of intended use) when testing against speech intelligibility criteria. One of the following will usually be required:

a. Open-field facility: An open field, free of all large buildings or high hills that would reflect or block sound energy, and having an ambient noise level equal to or below 50 dB(A).

b. Closed-room facility: A room or chamber similar in acoustic characteristics to the location in which the test item is used. Vehicle communication sets are tested in the vehicle(s) in which they are intended to be used. The ambient noise will vary with respect to the facility, and if no facility is specified, use 50 dB(A) as the maximum allowable ambient pressure level.

5.2.3.1.6 Air Conditioner Tests These tests require a chamber with an acoustical tile ceiling and a movable wall to provide a room of the size for which the air conditioner was designed. The room should be empty except for sound measuring instrumentation and electrical heater banks.

5.2.3.2 Instrumentation

5.2.3.2.1 Steady-State Noise System Steady-state noise measurement and recording equipment is described in TABLE 2-1. A sound level meter will suffice for surveying locations for high noise levels or if the test plan calls for a weighted average sound pressure level measurement. Where octave band frequency analysis is necessary, a recording and frequency analysis system will be necessary. Instrumentation should meet the following requirements:

a. Microphones shielded against wind effects, having a flat response at grazing incidence (90°) or having an essentially flat response at normal incidence (0°) shall be used. A random incidence corrector should be used with a one-inch microphone. Microphones must have a flat frequency response between 20 Hz and 18kHz.

b. Sound level meters conforming to the requirements for Type I as specified by ANSI S1.4.

c. Octave band filter sets conforming to the requirements for Type E, class II as specified by ANSI S1.11.

d. Magnetic tape recorder having a flat frequency response from 20 Hz to 18 kHz (± 2 dB).

e. Frequency analyzer providing dB(A), dB(B), dB(C) and octave-band levels.

5.2.3.2.2 Impulse Noise System Impulse noise measurement and recording equipment is described in TABLE 2-1. Instrumentation should meet the following requirements from MIL-STD-1474B(MI):

a. Microphones/transducers having a flat dynamic response of ±2 dB over the frequency range of 20 Hz to 70 kHz are required. Microphones having the appropriate dynamic range and rise-time characteristics should be used for measurements up to approximately 171 dB; transducers (blast gauges) should be used for measurements above 171 dB; both having suitable conditioning electronics.

b. Frequency modulated (FM) magnetic tape recorder: Having a frequency response up to 80 kHz (± 0.5 dB).

c. Digital oscilloscope or other suitable equipment to digitize peak intensity and duration of impulse noise.

5.2.3.2.3 Alternate Noise Instrumentation Any noise recording devices, components, or combinations of instrumentation used as part of or in lieu of the above items shall conform to ANSI S6.1 and applicable provisions of ANSI S1.4.

5.2.4 Method Noise measurement is required whenever there is a question whether or not noise levels associated with a test item would present problems for:

a. The health, safety, and performance capability of operators/maintainers.

b. The capability to conduct normal communications among operators/ maintainers.

c. The detectability of the item by enemy personnel.

d. Community annoyance.

5.2.4.1 General Guidelines Long duration exposure to high levels of noise may result in permanent loss of hearing capability. Personnel exposed to high noise levels are affected in terms of their performance capability. The effects of noise on performance can be direct effects where the noise field adversely affects the person's ability to perform operations. The effects are also indirect in that noise generally leads to fatigue which in turn results in performance decrements.

Exposure to noise also impacts performance through its effect on the capability to communicate. The effect of noise on communication must be determined both during the time that personnel are exposed to noise, and immediately after the exposure if personnel are in a situation where a high level of hearing ability is required (e.g., hearing whispered commands immediately after disembarking from a personnel carrier).

The effect of noise on detectability of an item in a combat situation also needs to be determined in an assessment of the noise levels associated with an item. However, the assessment of aural non-detectability would be conducted only if specifically required by the procuring agency.

Noise measurement generally involves sampling and recording noise intensities over the frequency range under representative operational conditions. The obtained noise measurements are then compared with noise limit criteria which specify maximum acceptable levels for personnel safety, communications, non-detectability and community annoyance.

However, it must first be determined if the item tested requires noise measurement. If the item has a source of noise incorporated in its operation, the HFE specialist should assess the likelihood of problems resulting from the associated noise. Where problems can be anticipated, a noise measurement test shall be incorporated into the HFE subtest. Also, as an insurance against the possible occurrence of unknown harmful effects, or when in doubt, a noise measurement test should still be performed.

Guidelines for assessing whether or not a noise test is required include:

a. The assessment used by the HFE specialist should be based on past experience with similar items having similar noise sources. If this experience is not available, the HFE specialist should arrange to inspect a sample test item which is fully activated or powered.

b. Determination should be made of the expected effects of noise on human performance, communications, safety, and health.

c. A sample of types of item components which should be assessed include:

(1) Motors, engines, and other power equipment
(2) Mechanical devices
(3) Weapons
(4) Air conditioners, fans, blowers, etc.
(5) Moving vehicles (wheeled or tracked)
(6) Aircraft.

When measuring noise, the following meteorological conditions should also be determined:

a. Temperature

b. Humidity

c. Barometric Pressure

d. Sky Cover

e. Ground Cover (especially snow conditions)

f. Wind Velocity and Direction.

5.2.4.2 General Test Conduct - Steady-State Noise

a. Determine measurement locations relative to the noise source. In general, measurements are made at all personnel positions or at locations called out in the test plan. See TOP 1-2-608 for additional test conduct information. Make a sketch showing the location and orientation of test item and each microphone location with respect to the test site.

b. Select appropriate facilities and instrumentation from that listed in paragraph 5.2.3.

c. Ensure that all instrumentation used has a valid calibration certification. Make an instrumentation calibration check at the test site prior to, during and immediately following the test measuring a sound of known frequency and sound pressure level using the microphone and recording system installed.

d. Equip all vehicles with a calibrated tachometer and speedometer.

e. When possible, select new vehicles for the test - vehicles that have completed the prescribed break-in time. Inspect for normal operation in accordance with the appropriate specification and to insure that all auxiliary equipment in continuous use when the vehicle is in motion is installed and operating normally.

f. Load all load-carrying vehicles (trucks, trailer, forklifts, etc.) with two-thirds of their usual rated payloads.

g. Install all panels, canvas, louvers, and equipment.

h. Check and adjust tire pressure or track tension to that prescribed for the load.

i. Check installation of safety equipment such as guards, mufflers, and warning devices.

j. Install all noise-producing auxiliary equipment normally used.

k. Prepare an acoustical test data sheet. Record information on the test item, the time and place of test trials, and the conditions under which the test is to be conducted. If steady-state noise data are to be recorded for later analysis, use recorded voice messages on the tape to identify the data.

l. All personnel exposed to hazardous noise or blast levels must wear appropriate hearing protection. Personnel who will be occupationally exposed to steady-state noise levels above 85 dB(A) shall be entered in a hearing conservation program as outlined in TB MED 501.

m. Weapon systems shall be remotely fired for all noise tests described in paragraph 5.2.4.9.

n. During tests, neither the operator nor crew members shall occupy the location(s) where the noise is being measured unless they are essential to the operation of the test item and the hearing protection provided is capable of reducing the expected noise to nonhazardous levels. When the presence of one or more operators is required, the sensing transducer will be mounted 6 in. (15 cm) from one ear of each person: for impulse noise measurements - 6 in. (15 cm) to the right of the right ear. If a wall or other reflecting surface is less than

12 in. (30 cm) from the ear, the microphone will be positioned equidistant from the ear and that surface. If necessary, a microphone can be helmet-mounted.

o. When no operator is present, the measurement shall be made at the center of the expected head positions. For standard test purposes, this position will be 60 in. (150 cm) above the ground plane for standing personnel. For aural non-detectability tests, the microphone height will be 48 in. (1.2 m) above the ground. For measurements at seated personnel positions, the microphone height will be 31.5 in. (80 cm) above the seat. Microphones should be secured in place using tripod mounts or other methods.

p. Ambient noise level for steady-state noise tests shall be at least 10 dB below the noise being measured.

q. Tests are not conducted when wind velocities exceed 12 mph (5.4 m/s) or during active precipitation. Microphones shall be shielded from wind effects under all conditions.

r. When the ambient temperature changes more than 5°F (2.8°C) during the conduct of the test, instrumentation calibration shall be performed after each series of measurements (5.2.4.2c).

s. Tests will be conducted with the test item configured and operated as expected during field training or combat conditions.

t. If equipment requires an external power generator or other similar aids, the test will be conducted with all appropriate subsystems operating.

Steady-state noise test procedures depend on the measurement objectives of the test and on the test item class. Types of steady-state noise tests include the following:

a. Noise levels at operator positions relative to the test item

b. 85 dB contour mapping

c. Aural non-detectability testing.

Details of the test procedures vary according to the test item class and, in the case of maneuvering vehicles, whether the vehicle is stationary or moving.

5.2.4.3 <u>Stationary Equipment - Steady-State Noise Tests</u>

5.2.4.3.1 <u>Generators, Pumps, Heaters, and Other Power Equipment</u>

a. Place microphones at the approximate centers of the probable head positions of all operating personnel and at positions 5 ft. (1.5 m) from each side and each end of the test item, 60 in. (150 cm) above the ground plane.

b. Operate equipment in a manner most similar to its normal operating conditions and record dB(A), dB(C), and octave-band pressure levels at all microphone locations. When the noise generated by operating conditions varies due to load, speed, or other reasons, conduct the test under that condition which produces the highest noise level.

c. When the operating noise level exceeds 85 dB(A) at a distance of 5 ft. (1.5 m), determine the distances and directions from the noise source at which the noise level is equal to 85 dB(A). Make as many readings as necessary to accurately plot an 85 dB(A) contour curve (See Paragraph 5.2.6.1a).

5.2.4.3.2 Air Conditioners

a. Mount the air conditioner in one end of the wall of the air conditioner test facility, with the evaporator side protruding at least 4 in. (10.2 cm) inside the wall as shown in FIGURE 5.2-1.

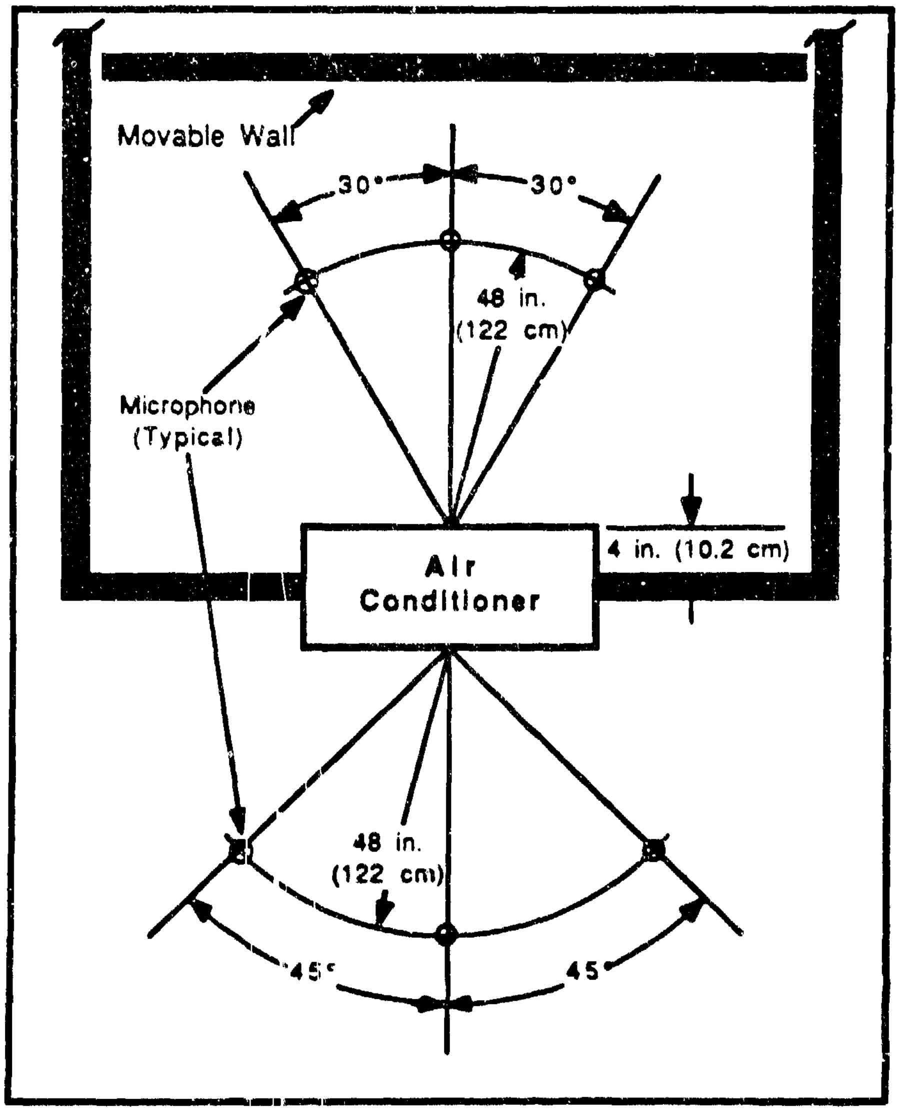

Figure 5.2-1. Air Conditioner Test Setup

b. Record the sound pressure level at three locations inside and three locations outside the test chamber as follows:

(1) Inside: On a centerline perpendicular to the evaporator grille, 30° to the left, and 30° to the right of the centerline. All positions are 48 in. (122 cm) from the center of the grille and 48 in. (122 cm) above the floor.

(2) Outside: On a centerline perpendicular to the condenser grille, 45° to the left, and 45° to the right of that centerline. All positions are 48 in. (122 cm) from the center of the grille and at a height on line with the center of the grille.

c. Operate the air conditioner at its maximum cooling capacity (coldest temperature setting and maximum blower speed) and record dB(A), dB(C), and octave-band pressure levels at each microphone location.

5.2.4.3.3 Parked Vehicles

a. Place microphones 6 in. (15 cm) to the right of the driver's right ear and at the center of the probable head location of the assistant driver, crew members, and passengers.

NOTE: When the occupants consist of a group of five or more persons in vehicles such as personnel carriers and buses, a noise survey will be made of all occupied spaces, and five positions covering the range from the highest to the lowest noise levels will be selected to represent the noise level for the entire crew.

b. Operate the vehicle at idle and at two-thirds of the maximum rated engine rpm or two-thirds of the posted vehicle speed. Operate vehicles having torque converters at stall conditions. Observe appropriate limitations on idle and stall operations to prevent overheating or damage.

c. Construct an 85 dB(A) contour curve around the exterior of the vehicle, recording at as many positions as necessary to accurately draw the curve (5.2.4.3.1c above).

d. Record dB(A), dB(C) and octave-band pressure levels at all interior microphone locations with windows open and again with windows closed.

e. Make additional noise measurements as necessary at all crew positions in the vicinity of any auxiliary equipment, such as heaters, blowers, and hydraulic pumps, with the engine at idle speed.

f. Rotary wing aircraft should be tested using the criteria and guidance in MIL-STD-1294.

5.2.4.4 Moving Equipment - Interior Noise

5.2.4.4.1 Wheeled Vehicles

a. Conduct steady-state noise measurements at interior operator positions with microphone placement as in 5.2.4.3.3a, but with the vehicle moving over a paved test course.

b. Operate the vehicle at two-thirds maximum rated engine speed or two-thirds of the posted vehicle speed in each of its forward gears over a paved test course (paragraph 5.2.3.1.2), with any auxiliary equipment that adds to the overall noise level (e.g., heaters, blower, air conditioners) in operation.

c. Record dB(A), dB(C) and octave-band pressure levels at each microphone location for each gear range with the windows or hatches both open and closed.

5.2.4.4.2 Tracked Vehicles Conduct the test as in 5.2.4.4.1 above except that when the tracks are without rubber pads, operate the vehicles on compact earth.

5.2.4.4.3 Small Watercraft (Applies to craft having fixed positions for crew and passengers and sound generated only by the propulsion unit.)

a. Place a microphone at the approximate ear positions of the operator, each crew member, and each passenger.

b. Operate the craft in calm water - waves of 6 in. (15 cm) or less - at five evenly spaced speed increments from slow to maximum speed.

c. Record dB(A), dB(C) and octave-band pressure levels at each microphone location for each speed.

5.2.4.4.4 Large Watercraft (Applies to vessels with multiple sources of noise.)

a. Operate the vessel in waters not to exceed moderate seas - waves of 3 ft. (0.9 m) or less - at varying speeds up to and including top speed (flank).

b. Conduct a noise survey of the pilot house, crew compartment, engine rooms, and work areas under all conditions of vessel operation using a sound level meter. With all special equipment normally used in that compartment operating, determine positions of maximum noise.

c. Place a microphone in the area of maximum noise of each compartment and record the dB(A), and octave-band pressure levels for the condition of vessel operation that produces the most noise.

d. When cargo handling, vehicle movement, or pumping operations are part of the normal working operation of the vessel, conduct a separate test of each of these operations while the vessel is moored.

5.2.4.4.5 Rotary Wing Aircraft Conduct the test using guidance in MIL-STD-1294.

5.2.4.5 Moving Equipment - Exterior Noise (Drive-By)

5.2.4.5.1 Motor Vehicles (SAE J366B, TOP 1-2-608)

a. Place a microphone 50 ft. (15.2 m) from, and perpendicular to, the centerline of the vehicle path as shown in FIGURE 5.2-2, 5 ft. (1.5 m) above the ground plane. Place a marker 50 ft. (15.2 m) in front of the microphone centerline.

b. If a sound level meter is being used, set the meter for fast response on the A-weighted network.

c. Operate the vehicle toward the marker at two-thirds maximum rated engine speed or two-thirds of the posted vehicle speed, in a gear that will allow the vehicle, when fully accelerated, to reach the maximum engine speed between 10 and 50 ft. (3 and 15 m) beyond the microphone centerline without exceeding 35 mph (56 km/h) before reaching the end line.

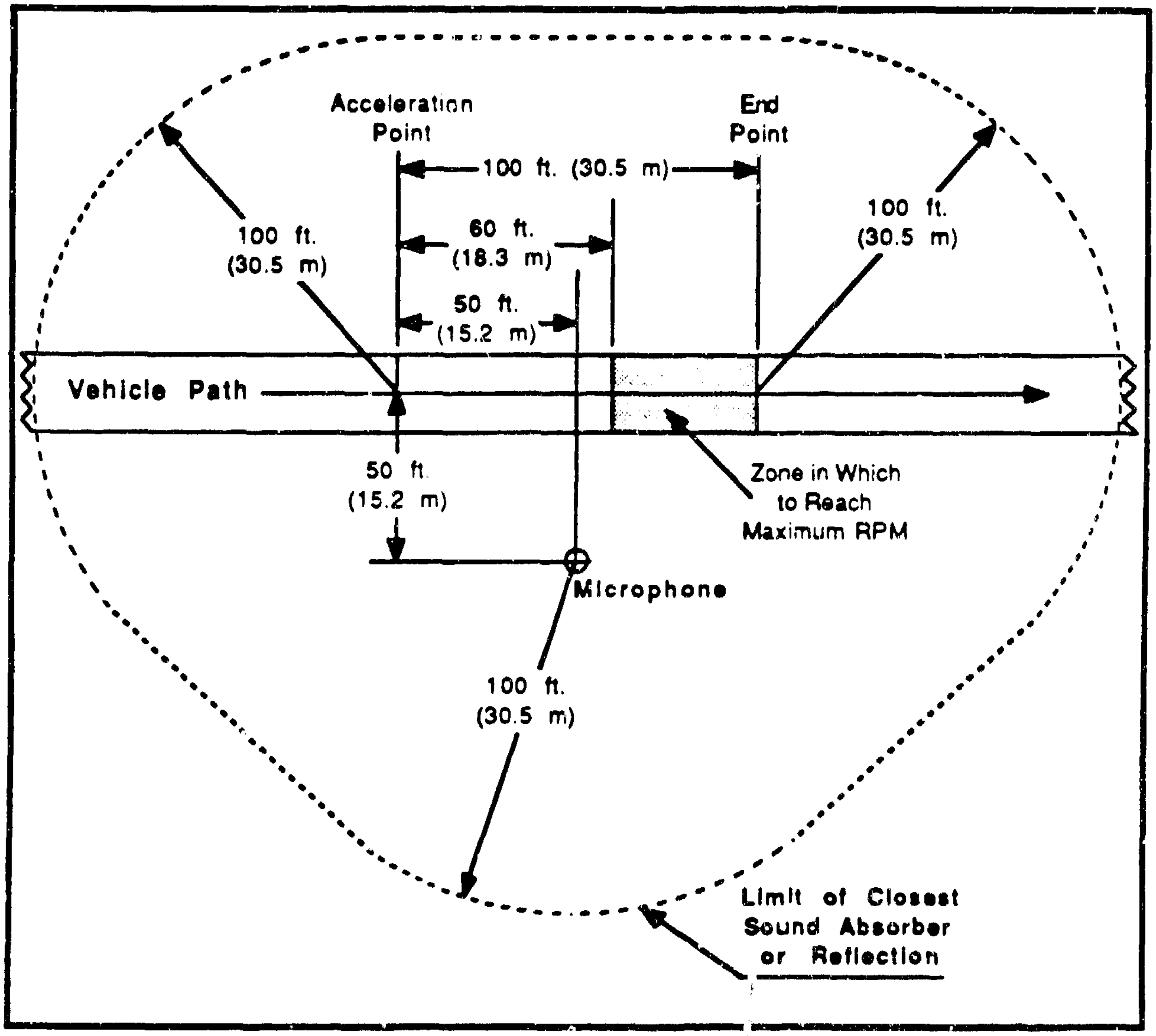

Figure 5.2-2. Motor Vehicle Test Course

d. Observe the sound level meter during the period that the vehicle is accelerating and record maximum dB(A) values as the vehicle is driven past the microphone. The applicable reading is the highest sound level obtained for the run (ignoring peaks caused by extraneous ambient noises).

e. Make at least three measurements on each side of the vehicle unless it becomes obvious after the first run that one side is definitely higher in sound level. Report the sound level for the side of the vehicle with the highest readings.

f. Report the sound level as the average of the two highest readings that are within 2 dB of each other.

5.2.4.5.2 Powered Mobile Construction Equipment (From SAE Procedure J-366B; for further details see SAE J88A.) Conduct this test using the same procedure as in 5.2.4.5.1 above except:

a. Place the microphone 50 ft. (15.2 m) from, and perpendicular to, the longest side surface of the equipment being tested as shown in FIGURE 5.2-3, 4 ft. (1.2 m) above the ground plane.

b. Operate self-propelled equipment in a forward intermediate gear over the prescribed course as shown in FIGURE 5.2-3 at full governed engine speed. Operate hydrostatic or electrically driven equipment as nearly as possible to one-half its maximum ground speed.

c. Test scrapers, spreaders, water distributors, and other equipment having major noise-generating machinery with that machinery in operation.

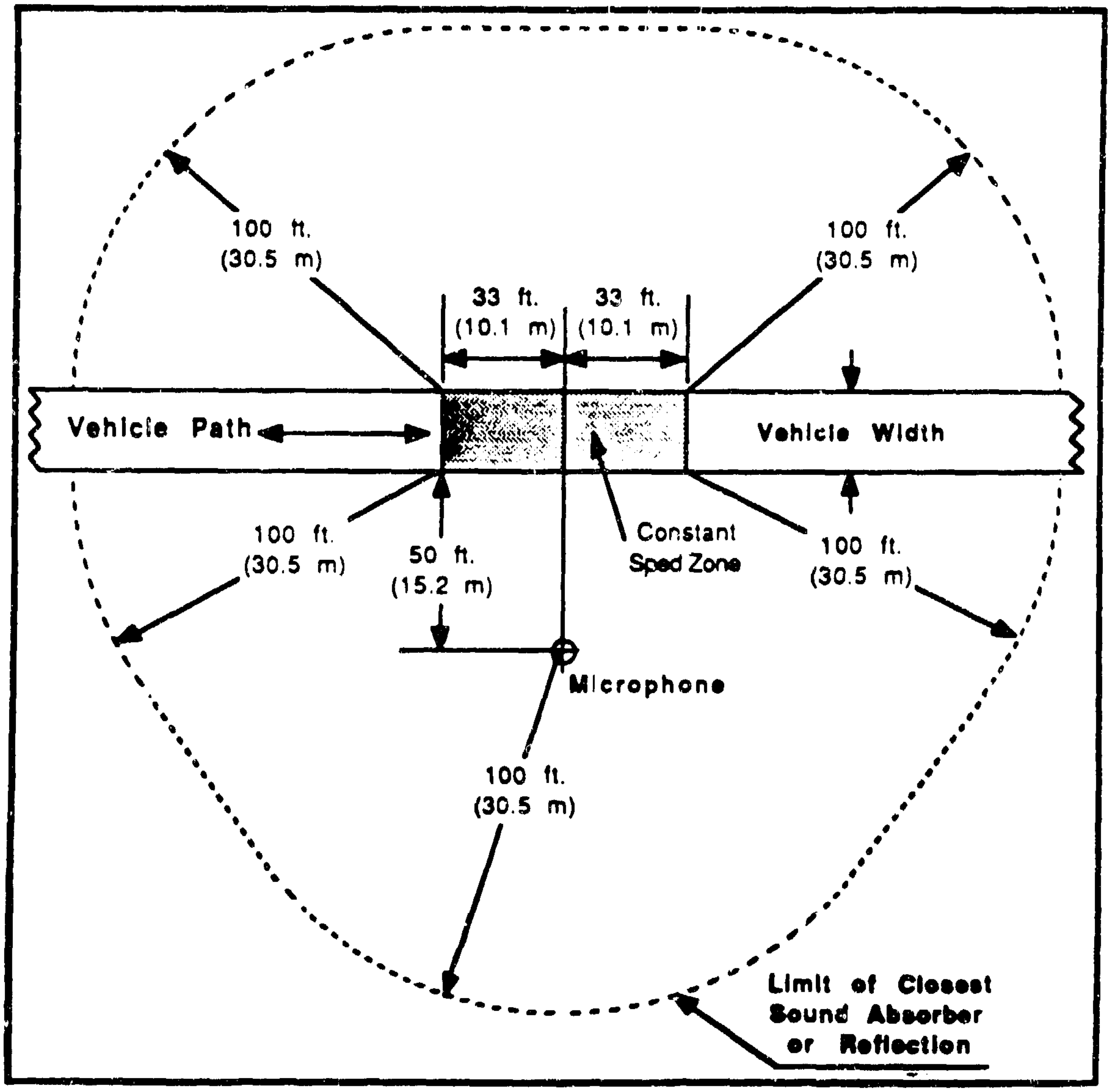

Figure 5.2-3. Powered Mobile Construction Equipment Test Course

5.2.4.5.3 Watercraft

a. Place a microphone 50 ft. (15.2 m) from the line described by three course markers on a dock, a floating platform, or another boat. Position the microphone so that it is perpendicular to the line of markers, opposite the center marker at 4 to 5 ft. (1.2 to 1.5 m) above the water surface, and not closer than 2 ft. (0.6 m) to the surface of the dock or platform on which the microphone stands.

b. If a sound level meter is being used, set it for for fast response on the A-weighting network.

c. Operate the craft so that it passes within 1 to 3 ft. (0.3 to 0.9 m) of the far side of all three markers with the engine operating at the midpoint of the full-throttle rpm range recommended by the manufacturer.

d. Observe the sound level meter while the craft is passing the markers and record the maximum dB(A) reading.

e. Make at least three measurements for each side of the craft.

f. Report the sound level for each side of the craft as the average of the two highest readings.

5.2.4.6 Aural Non-detectability Tests Select from Table 3 of MIL-STD-1474B(MI) a measurement distance that corresponds to the nominal non-detectability range desired or requested by the requirements document. Unless otherwise specified, the octave band pressure levels measured at the "measurement distances" must not exceed those values listed in the table for any band if non-detectability is to be achieved at the corresponding distances. If the ambient noise is less than 10 dB below the level of the test item, the use of conventional background noise corrections is permissible (ANSI SI.13). If the test item is small and meets the safety requirements, the test may be conducted in an anechoic chamber. When measuring the noise of a large item at close distances, the measurement distance must be more than three times the major dimension of the item.

5.2.4.6.1 Vehicle Stationary - Silent Watch

a. Place a microphone 4 ft. (1.2 m) above the ground plane at a measurement distance selected from Table 3 of MIL-STD-1474B(MI).

b. Record the ambient sound pressure levels in each octave band with the vehicle completely silent.

c. Place the vehicle in a silent watch condition: i.e., radio, rangefinder, and other electronic equipment turned on and all other noise-producing devices or equipment turned off.

d. Make a noise survey around the vehicle using a portable sound level meter to determine that side which produces the maximum noise. Orient the vehicle so that the noisiest side faces the microphone and record the sound pressure levels in each octave band.

5.2.4.6.2 Vehicle Stationary - Combat Readiness Repeat the procedure described in paragraph 5.2.4.6.1 above with the vehicle engine at idle and all heaters, weapon systems, and electronic instruments operating.

5.2.4.6.3 Vehicle Moving

a. Place the microphone in the center of a circle of 164 ft. (50 m) radius and record the ambient sound pressure level in each octave band.

b. Operate the vehicle in both clockwise and counterclockwise directions at speeds of 5, 10, 15, and 20 mph (8, 16, 24, and 32 km/h) and record the sound pressure level in each octave band.

NOTE: If there are variations in the sound pressure level with respect to vehicle position on the course, use only those positions producing the highest readings to determine the nondetectable distance.

5.2.4.6.4 Equipment at Idle (Standby Condition)

a. Place the microphone at the selected distance from the test item. While the item is completely silent, record the ambient sound pressure level in each octave band.

b. Turn on the equipment to its lowest operable condition (idle) and again record the sound pressure level in each band.

NOTE: Orient the test item so that the side of the test item generating the highest noise level is facing the microphone. Make an octave band analysis at this point.

5.2.4.6.5 Equipment at Maximum Working Condition Use the procedure described in paragraph 5.2.4.6.4 above except with the test equipment at its normal maximum load condition. Exception: If, by reducing or increasing the speed or working condition of the test item, the noise level increases, conduct the test at that speed or condition that produces the higher noise level unless it is detrimental to the test item to do so.

5.2.4.7 Speech Intelligibility Tests For equipment that requires effective oral communication among crew or passengers for field employment, a speech intelligibility test may be necessary. Such a test is particularly important if the sound pressure levels recorded at each significant crew or passenger position (as determined in accordance with 5.2.4.3 or 5.2.4.6 above) approach or exceed the noise limits stated in paragraph 5.1.1 of MIL-STD-1474B(MI). When required, the speech intelligibility test is conducted as described in Test Procedure 5.5.

5.2.4.8 Typical Duty Cycle Tests When the typical duty cycle noise level is specified by the requirements document, determine the equivalent continuous noise level (Leq*) of the test item as described in MIL-STD-1474B(MI).

5.2.4.9 General Guidelines - Impulse Noise For test purposes, impulse noise is defined as short burst of acoustic energy consisting of either a single impulse or a series of impulses. The pressure-time history of a single impulse includes a rapid rise to a peak pressure, followed by a somewhat slower decay of the pressure envelope to ambient pressure, both occurring within 1 second. A series of impulses may last longer than 1 second. The following data are required for the evaluation of impulse noises:

a. Peak pressure level in dB or psi.

b. A-duration: The time required for the initial positive pressure pulse to rise from ambient pressure to peak amplitude and return momentarily to the ambient level (See Figures 8-11 in MIL-STD-1474B(MI)).

c. B-duration: The total time that the envelope encompassing successive pressure fluctuations (positive and negative) of the primary portion of an impulse noise is within 20 dB of the peak pressure level, plus the time intervals that any subsequent fluctuations (reflective pulses) are within 20 dB of the peak pressure level (See Figures 8-11 in MIL-STD-1474B(MI)).

5.2.4.10 General Test Procedure - Impulse Noise The following procedures apply to all impulse noise tests that follow.

a. Determine measurement locations relative to the noise source. In general, measurements are made at all personnel positions or at locations called out in the test plan. See TOP 1-2-608 for additional test conduct information. Make a sketch showing the location and orientation of test item and each microphone/transducer location with respect to the test site.

b. Select appropriate instrumentation in accordance with paragraph 5.2.3.2. When the expected pressure levels are in excess of 171 dB (6.9 kPa or 1 psi), use suitable pressure transducers (e.g., blast gauges); when expected levels are below 171 dB (6.9 kPa or 1 psi), use fast-response microphones. Record impulse noise with an FM tape recorder having a flat ($\pm$0.5 dB) frequency response up to at least 80 kHz. (If speed reduction techniques and direct readout devices are used in the analysis of the recorded noise data, the frequency response characteristics of the devices must be at least proportionally equivalent to the characteristics of the recording device.)

c. Ensure that all instrumentation used has a valid calibration certification. Make an instrumentation calibration check at the test site prior to, during and immediately following the test measuring a sound of known frequency and sound pressure level using the microphone and recording system installed.

d. Prepare an impulse noise data form showing the microphone positions used. Record peak pressure level in dB and A-duration and B-duration in suitable time units for each microphone location and each replication of the test (weapon firing, etc.). Record information on the test item, the time and place of test trials, and the conditions under which the test is to be conducted. Use recorded voice messages on the tape recorder to identify the data.

e. All personnel exposed to hazardous noise or blast levels must wear appropriate hearing protection. Personnel who will be occupationally exposed to peak pressure levels of impulse noise above 140 dB shall also be entered in a hearing conservation program as outlined in TB MED 501.

f. Weapon systems shall be remotely fired for all noise tests described in paragraph 5.2.4.9.

g. During tests, neither the operator nor crew members shall occupy the location(s) where the noise is being measured unless they are essential to the operation of the test item and the hearing protection provided is capable of reducing the expected noise to nonhazardous levels. When the presence of one or

more operators is required, the sensing transducer will be mounted 6 in. (15 cm) from one ear of each person: for impulse noise measurements - 6 in. (15 cm) to the right of the right ear. If a wall or other reflecting surface is less than 12 in. (30 cm) from the ear, the microphone will be positioned equidistant from the ear and that surface. If necessary, a microphone can be helmet-mounted.

h. When no operator is present, the measurement shall be made at the center of the expected head positions. For standard test purposes, this position will be 60 in. (150 cm) above the ground plane for standing personnel and 31.5 in. (80 cm) above the seat for seated personnel. Microphones should be secured in place using tripod mounts or other methods.

i. Ambient noise level for steady-state noise tests shall be at least 25 dB below the noise being measured.

j. Tests are not conducted when wind velocities exceed 12 mph (54 m/s) or during active precipitation. Microphones shall be shielded from wind effects under all conditions.

k. When the ambient temperature changes more than 5°F (2.8°C) during the conduct of the test, instrumentation calibration shall be performed after each series of measurements.

l. If impulse noise measurements are to be taken at operator positions within a test item (such as a vehicle), tests will be conducted with the test item configured and operated as expected during field training or combat conditions.

m. Measure peak pressure level, A-duration and B-duration from data recorded during each of at least three separate tests. Use the arithmetic means of the peak pressure levels, A-durations and B-durations from these (three or more) tests (if consistent) to define the impulse noise when the range of peak pressure levels does not exceed 3 dB. If the range of peak pressure levels exceed 3 dB, conduct additional tests until the number of measurements equals or exceeds the range in dB.

n. When possible, take data analysis equipment to the test site to determine whether the peaks of the recorded impulse noises are within the 3 dB range. If analysis equipment cannot be taken to the test site, fire additional rounds/detonations (if economically feasible) or arrange additional impacts (paragraph 5.2.4.13) to provide greater assurance of an adequate test.

o. To map a 140-dB noise contour curve:

(1) Place a transducer 5 ft. (1.5 m) above the ground plane as close to the test item as is considered safe (in accordance with associated guidance documents) and on each 30° radial line centered at the test item (paragraph 5.2.6.2c). If the weapon can be considered symmetrical, measurements may be made on one side only.

(2) Place a second series of transducers, a third series of transducers twice the distance as the second, and finally a fourth series of transducers twice the distance as the third. From this configuration of transducers, a 140-dB noise contour curve around the test item can be predicted by interpolation.

5.2.4.11 Weapon Firing Tests Conduct the following tests on an appropriate firing range (paragraph 5.2.3.1.7). Unless otherwise stipulated, position all weapons under realistic conditions comparable to those employed in combat or training missions.

5.2.4.11.1 Hand-Held and Shoulder Weapons

a. Mount hand-held and shoulder weapons in a test firing fixture with their barrels or tubes 5 ft. (1.5 m) above and parallel to the ground plane.

b. Mount one sensing transducer at the center of the probable head position of the operator and another sensing transducer 6 ft. (2 m) to left or right of the muzzle at the same height as the muzzle.

c. Remotely fire these rounds allowing enough time between rounds for the noise pulses from the preceding round to decay to ambient before the next round is fired. When automatic weapons are tested, it may be necessary to load the weapon one round at a time.

d. Record peak pressure, A-duration, and B-duration for each round.

5.2.4.11.2 Rifle with Grenade Launcher

a. Mount the rifle in a test firing fixture with the rifle butt resting on the ground and the barrel elevated to its maximum safe position for launching grenades.

b. Mount one sensing transducer at the center of the probable head position of the operator and another transducer 6 ft. (2 m) to the left or right of the muzzle at the same height as the muzzle.

c. Launch at least three grenades and record the peak pressure, A-duration, and B-duration of each launching as outlined in paragraph 5.2.4.10c.

5.2.4.11.3 Machine Guns (Tripod Mounted)

a. Mount the machine gun in a test firing fixture representative of its normal tripod mounting condition.

b. Mount a sensing transducer at the center of the probable head position of each crew member, and mount another sensing transducer 6 ft. (2 m) to the left of the muzzle at the same height as the muzzle.

c. Fire three separate rounds with enough time between rounds for the pulse envelope to decay to ambient before the next round is fired. Record peak pressure, A-duration and B-duration in accordance with paragraph 5.2.4.10c.

5.2.4.11.4 Recoilless Rifles

a. Mount the recoilless rifle in a firing fixture so that the tube is 5 ft. (1.5 m) above and parallel to the ground plane.

b. Mount a sensing transducer at the center of the probable head position of each crew member (gunner and assistant gunner), and mount additional sensing transducers at as many positions around the weapon as necessary to describe the noise contour curve (paragraph 5.2.4.10e).

c. Fire a minimum of three rounds and record peak pressure levels, A-durations, and B-durations at the crew positions and the peak pressures around the test item to establish the 140-dB noise contour curve.

5.2.4.11.5 Mortars

a. Position the weapon for remote firing so that the mortar tube is facing downrange.

b. Mount a sensing transducer at the center of the probable head position of each crew member; mount another sensing transducer 6 ft. (2 m) to the left or right of the muzzle at the same height as the muzzle; and mount additional sensing transducers at as many locations as necessary to accurately describe the noise contour curve (paragraph 5.2.4.10e).

c. Conduct tests with the weapon positioned at both the minimum and maximum safe tube elevations.

d. Fire a minimum of three rounds and record the peak pressure levels, A-durations, and B-durations at the crew positions and the peak pressures around the test item to establish the 140-dB noise contour curve.

5.2.4.11.6 Small Arms Mounted in Vehicles

a. Mount the weapons in or on the vehicles as they would be under normal combat or training conditions.

b. Position the vehicle to create the most severe noise conditions with respect to the crew members (e.g., gun firing directly over the hatch of a crew member) when firing the weapon downrange.

c. Mount a transducer at the center of the probable head position of each crew member while in a seated position.

(1) With the vehicle hatches closed, fire the weapon and record sound pressure level, A-duration and B-duration at each crew position.

(2) Repeat the above test with the hatches open.

d. Mount a transducer at the center of the probable head positions of all crew members simulating their heads protruding from an open hatch. Fire the weapon and record the data as in c above.

5.2.4.11.7 Towed Artillery

a. Position the weapon on an appropriate range in the same manner as it would be used for the training of personnel. Elevate the muzzle to the position (within the range safety limits) that produces the highest noise level achieved in normal fire (excluding direct fire).

b. Mount a sensing transducer at the center of the probable head position of each crew member and instructor and mount additional sensing transducers at as many locations around the weapon as necessary to accurately construct a 140-dB noise contour curve (paragraph 5.2.4.10e).

c. Fire the weapon as many times as necessary, but a minimum of three, to establish the peak pressure, A-duration, and B-duration for each transducer location in accordance with paragraph 5.2.4.10c.

5.2.4.11.8 Self-Propelled Artillery (Open Mount)

a. Position the vehicle on an appropriate range so that the gun is facing forward with respect to the vehicle and downrange. Raise the muzzle to the elevation (within the range safety limits) that produces the highest noise level.

b. Proceed with the test as in 5.2.4.11.7 above.

5.2.4.11.9 Self-Propelled Artillery (Closed Mount or Turret)

a. Position the vehicle on an appropriate range so that the gun is facing forward with respect to the vehicle and downrange. Raise the muzzle to the elevation (within the range safety limits) that produces the highest noise level.

b. Mount a sensing transducer at the center of the probable head position of each crew member while seated in the vehicle. All hatches are to be closed during firing.

c. Mount a sensing transducer 50 ft. (15.2 m) to the left or right of the muzzle and 5 ft. (1.5 m) above the ground plane (to represent an adjacent vehicle).

d. Fire the weapon as many times as necessary, but a minimum of three, to establish the peak pressure, A-duration and B-duration for each transducer location in accordance with paragraph 5.2.4.10c.

5.2.4.11.10 Air Defense Weapons

a. Position the weapon on an appropriate firing range so that it is facing downrange. Elevate the gun muzzle to the position (within the range safety limits) that produces the highest noise level achieved in normal firing.

b. Mount sensing transducers at the center of the probable head positions of all crew members and operating personnel, and mount as many sensing transducers around the weapon as necessary to accurately map a 140-dB noise contour curve (paragraph 5.2.4.10e) around the weapon.

c. Fire the weapon as many times as necessary, but a minimum of three, to establish the peak pressure, A-duration and B-duration for each transducer location in accordance with paragraph 5.2.4.10c.

5.2.4.12 Explosive Ordnance Tests For these tests, noise-measuring efforts are concerned primarily with determining the area of noise hazard around the ordnance item rather than at an operator position.

a. Mount as many sensing transducers around the ordnance item as necessary to map a 140-dB noise contour curve (paragraph 5.2.4.10e).

b. Record the peak pressure level, A-duration and B-duration at each transducer location for as many detonations as considered feasible. The arithmetic averages of the peak pressure level, A-duration and B-duration for as many devices as were detonated will constitute the final results.

5.2.4.12.1 Mines

a. Plant the mine as directed by the operational procedure in an open field and set it for remote detonation.

b. Follow the test procedure in 5.2.4.12 above.

5.2.4.12.2 Grenades

a. Place the grenade in an open field 5 ft. (1.5 m) above the ground plane.

b. Follow the test procedure in 5.2.4.12 above

5.2.4.12.3 Bombs

a. Place the bomb on the surface of a field or other materiel for which the bomb was designed. Prepare the bomb for remote detonation.

b. Follow the test procedure in 5.2.4.12 above.

5.2.4.12.4 Demolition Charges

a. Place or mount the demolition charge in or on a simulated fixture for which the charge was designed 5 ft. (1.5 m) above the ground plane.

b. Prepare the demolition charge for remote detonation.

c. Follow the test procedure in 5.2.4.12 above.

5.2.4.13 Materiel Other Than Weapons and Explosive Ordnance Items such as machinery (drophammers, jackhammers, etc.) and impact tools that produce impulse noises are tested not only against impulse noise criteria but also against steady-state criteria when appropriate. For impulse noise tests a minimum of five separate impulses are required to establish the arithmetic means of peak pressure level, A-duration and B-duration as described in paragraph 5.2.4.10c.

5.2.4.13.1 Stationary Machinery (e.g., Drophammers)

a. Since these test items are not portable, they may be tested within an enclosure, the most suitable of which is the room or area of their intended use.

b. Place sensing transducers at the center of the probable head positions of all operators, helpers, and maintenance and observer personnel.

c. Mount as many transducers around the test item as necessary to accurately record and map a 140-dB noise contour curve of the item (paragraph 5.2.4.10e).

d. Operate the machine using the operation and materiel that causes the highest noise level.

e. Make as many machine operations as necessary to assure completeness of noise data for the determination of peak pressure level, A-duration B-duration and the noise contour curve.

5.2.4.13.2 Portable Machinery (e.g., Pneumatic Hammers)

a. Conduct these tests in an open area free of all reflecting surfaces and where the ambient sound pressure level is at least 25 dB below the values expected during the tests.

b. Mount sensing transducers at the center of the probable head positions of the operator and all other personnel required in the area during the operation.

c. Mount as many transducers around the setup as necessary to accurately record and map a 140-dB noise curve of the item (paragraph 5.2.4.10e).

d. Operate the equipment using the operation and materiel causing the highest noise level and for as many operations as necessary to determine peak pressure level, A-duration, B-duration and the noise contour curve.

e. If the portable machinery requires other equipment in support of its operation (such as generators or air compressors), test the supporting equipment also for its steady-state noise level as indicated in 5.2.4.13 above.

5.2.5 Data Required

5.2.5.1 Steady State Noise Record the following data for each test:

a. Test nomenclature and identification data.

b. Test item condition (e.g., hatch position, with or without muffler, percent load, speed, etc.).

c. Test site (surface, terrain, etc.).

d. Type of test (stationary, highway, drive-by, etc.).

e. Meteorological data (temperature, humidity, barometric pressure, sky cover, wind direction, and velocity).

f. Nomenclature, model and serial numbers, and manufacturer of all instruments used.

g. Test conductor and equipment operator.

h. Microphone locations.

i. Sound levels in dB(A), dB(C), and in each octave band.

j. Noise contour data (distances and directions from the equipment at which 85 dB(A) is measured).

5.2.5.2 Impulse Noise Record the following data (as applicable) for each test conducted.

a. Test item nomenclature and identification data.

b. Type of ammunition for explosive charge.

c. Test item condition (type mount, hatch position mounting method, etc.).

d. Components and on board equipment included.

e. Meteorological data (temperature, humidity, barometric pressure, sky cover, wind direction, and velocity).

f. Nomenclature, model and serial numbers, and manufacturer of all instruments used.

g. Test conductor and equipment operator.

h. Microphone locations.

i. Peak pressure level, A-duration and B-duration measurements of impulse noise for each microphone location.

j. Noise contour data (distance and directions from the test item at which 140 dB peak is recorded).

5.2.6 Data Reduction and Presentation

5.2.6.1 Steady-State Noise

a. Tabulate all direct sound level meter measurement data using a data collection sheet similar to that in FIGURE 7 of MIL-STD-1474B(MI).

b. When data are recorded on magnetic tape, analyze the data in the laboratory for each specified requirement. If a requirement is not specified:

(1) Analyze the data for dB(A), dB(C), and octave-band sound levels in each octave band.

(2) Extract a portion of each test segment from the magnetic tape and perform a frequency analysis.

c. Present data taken for 85-dB(A) contour curves as shown in FIGURE 5.2-4.

d. When required, compute the equivalent continuous noise level (Leq*) as described in MIL-STD-1474B(MI).

e. Assess the noise conditions referring to the steady-state noise level criteria in MIL-STD-1474B(MI) for the following, as applicable:

(1) Minimum distance personnel may approach without hearing protection.

(2) Type of hearing protection required.

(3) Type of communication possible.

(4) Distance of probable communication.

(5) Speech intelligibility.

(6) Maximum detectable distance.

(7) Primary sources of noise (i.e., exhaust, tracks, etc.).

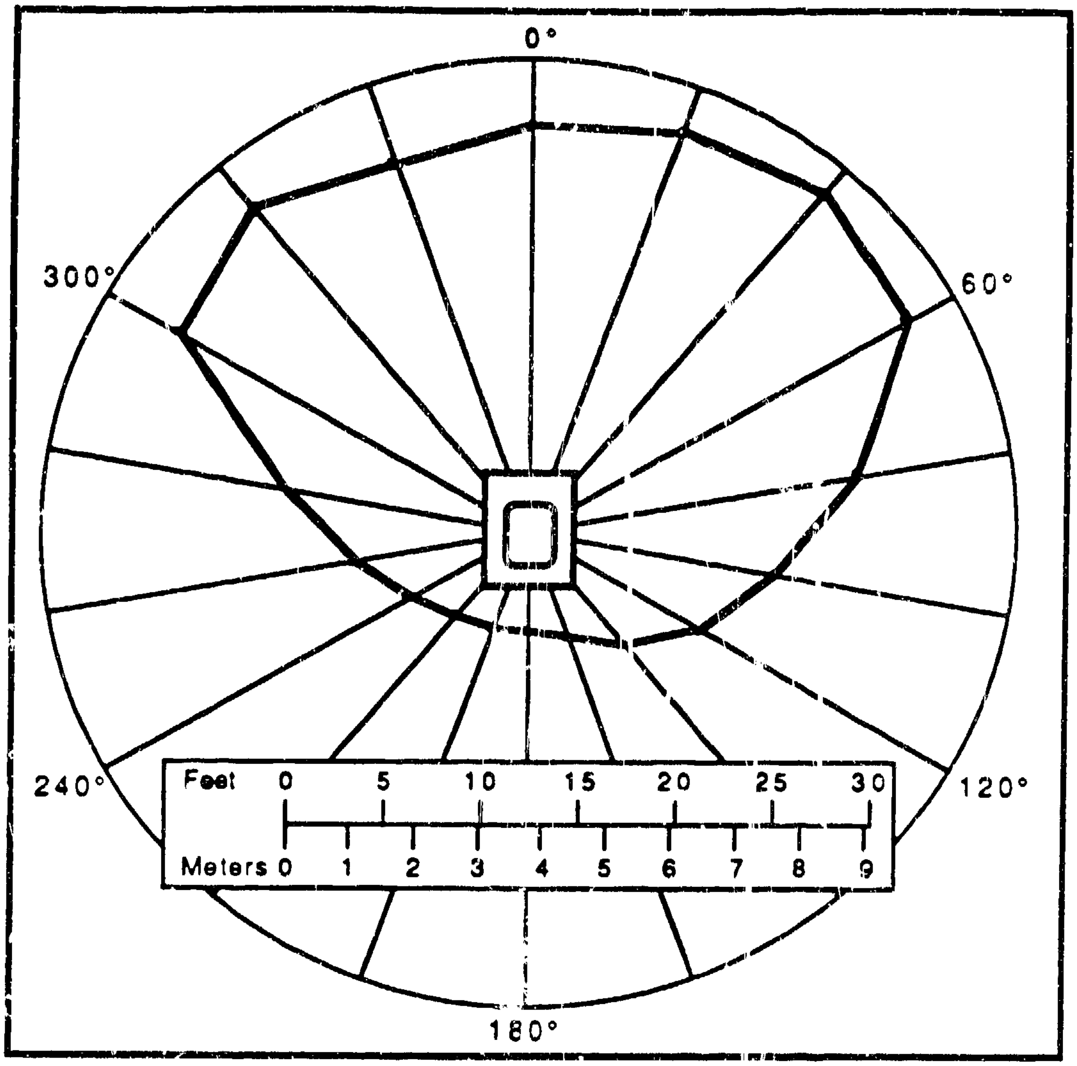

Figure 5.2-4. Typical 85 dB(A) Noise Contour Curve for a Military Vehicle

5.2.6.2 Impulse Noise

a. Analyze the impulse noise data recorded on magnetic tape using an oscilloscope to determine peak pressure level, A-duration and B-duration as described in MIL-STD-1474B(MI).

b. Tabulate the data taken to determine safety conditions for personnel. When making comparison noise tests between two types of weapons or ammunition, or to determine whether a simulator is loud enough to represent the actual device, only peak pressure levels are required and are reported by round number.

c. Present data taken for 140-dB contour curves as shown in FIGURE 5.2-5.

d. Assess the noise condition referring to the impulse noise level criteria in MIL-STD-1474B(MI), for the following as applicable.

(1) Minimum distance personnel may approach the area without hearing protection.

(2) Type of hearing protection required.

(3) Maximum detectable distance.

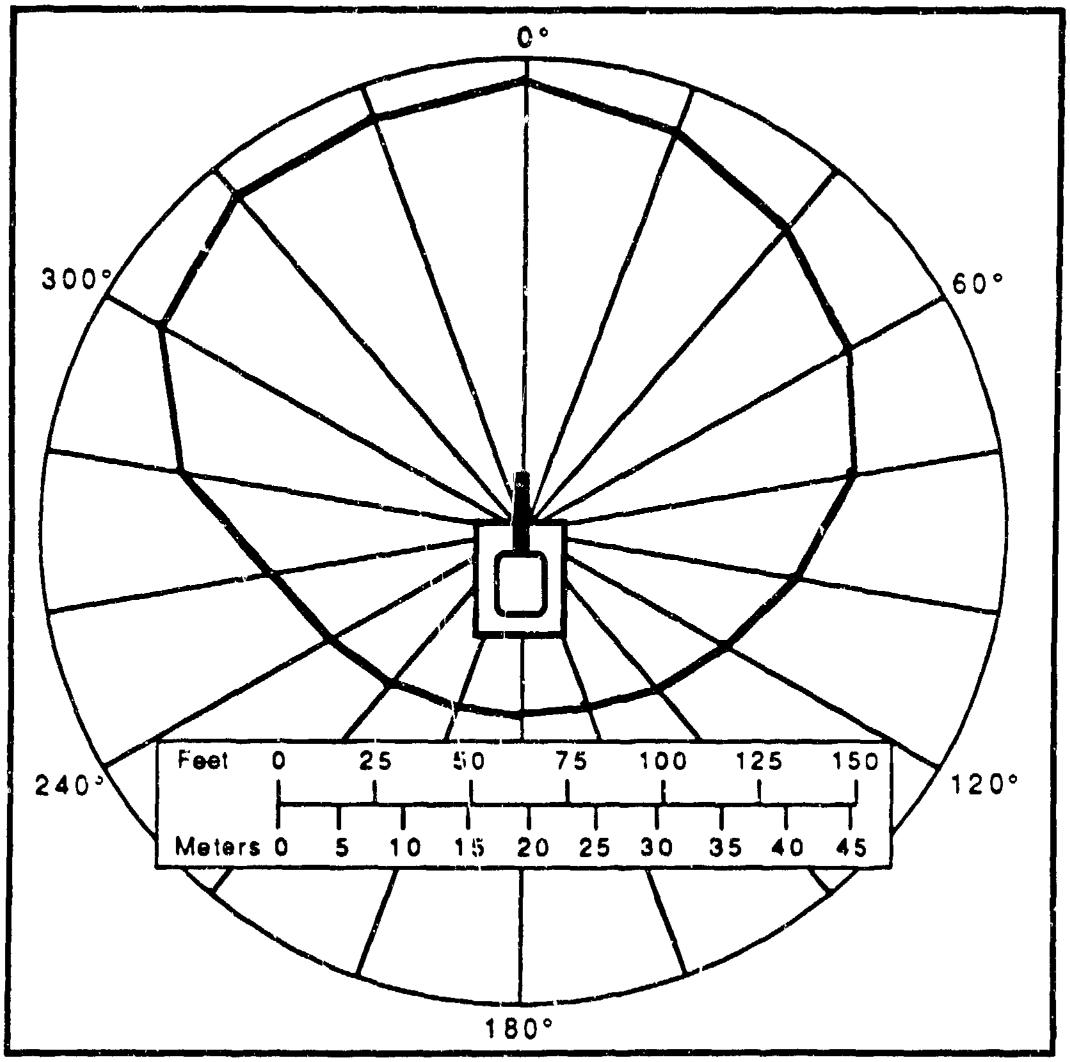

Figure 5.2-5. Typical 140 dB Noise Contour Curve for a Weapon Firing Test

5.3 TEST PROCEDURE
TEMPERATURE, HUMIDITY, AND VENTILATION MEASUREMENT

5.3.1 Objective The purpose of this procedure is to present methods and criteria for the evaluation of temperature, humidity, and ventilation. The procedures outlined in this section apply to enclosed areas that have controls for these environmental factors and to enclosures that meet these provisions with the exception of Wet Bulb Global Temperature (WBGT), which applies to the outdoor environment and to enclosed areas without any means to control these environmental factors.

5.3.2 Criteria

5.3.2.1 Air Temperature, Humidity and Ventilation Criteria Dry-bulb air temperature, humidity and ventilation criteria are provided in paragraph 5.8.1 of MIL-STD-1472D in connection with requirements for heating, air conditioning and ventilation equipment. Additional criteria and methods are provided in documentation listed in Appendix F of Part I. The following criteria are applicable to test items which have personnel enclosures.

a. Heating shall be provided within mobile personnel enclosures utilized for detail work or occupied during extended periods of time to maintain interior dry bulb temperature above 50°F (10°C). A minimum of 68°F (20°C) shall be maintained within permanent and semi-permanent facilities. Heating systems shall be designed such that hot air discharge is not directed on personnel.

b. Adequate ventilation shall be assured by introducing a minimum of thirty cubic feet per minute per person into any personnel enclosure; approximately two-thirds should be outside air. Air shall be moved past the person at a rate less than 100 fpm (30 mpm) if possible to preclude loose papers from being blown off work surfaces. Intakes for ventilation systems shall be so located as to minimize the introduction of contaminated air from such sources as exhaust pipes, etc.

c. Air conditioning shall be provided if the effective temperature within personnel enclosures utilized for detail work during extended periods exceeds 85°F (29°C). (See FIGURE 38 in MIL-STD-1472D). Air conditioning systems shall be designed such that cold-air discharge is not directed on personnel.

d. Humidity values should approximate 45 percent relative humidity at 70°F (21°C). This value should decrease with rising temperatures, but should remain above 15 percent to prevent irritation and drying of body tissues, e.g., eyes, skin, and respiratory tract. (See FIGURE 40 in MIL-STD-1472D).

e. In providing for heating and cooling of enclosed areas, it is important that the temperature of the enclosed area be held relatively uniform. The temperature of the air at floor level and at head level should not differ by more than 10°F (6°C).

f. When special protective clothing or personal equipment, including full and partial pressure suits, fuel handler suits, body armor, cold regions clothing and temperature regulated clothing are required and worn, a comfort micro

climate between 68°F (20°C), 14 mm Hg ambient water vapor pressure and 95°F (35°C), 3 mm Hg ambient water vapor pressure shall be maintained by heat transfer systems.

g. Temperature and humidity exposure should not exceed the tolerance limits given in FIGURE 40 in MIL-STD-1472D when corrected for air flow rate.

h. In addition to the specific criteria cited above, information is presented below of a more general nature but useful to the HFE specialist in his/her overall evaluations of the environment.

(1) During the summer, the comfort zone is between 65°F and 75°F (18°C and 24°C). During winter it is 63°F to 71°F (17°C to 22°C).

(2) Humidities between 30 and 70 percent generally represent the comfortable range. Humidity values should approximate 45 percent relative humidity at 70°F (21°C).

(3) The reference temperature for seated personnel is measured 24 inches above the seat reference point (S.R.P.). In cold environments, cab compartments should maintain a temperature no lower than 50°F (10°C) (dry bulb).

(4) Temperature measures (dry bulb) should be taken at the floor level, hand use, and head and face areas, and at various body positions. The temperature should not vary more than 15°F (8°C) above and 10°F (6°C) below the reference temperature. The heating system should achieve these requirements within one hour after it is turned on.

(5) TABLE 5.3-1 indicates general effects of temperature on human subjects.

(6) FIGURE 5.3-1 indicates the relationship between temperature and humidity as it affects the general comfort of the individual.

(7) Skin temperatures as they relate to different degrees of comfort are presented in TABLES 5.3-2 and 5.3-3.

(8) FIGURE 5.3-2 shows the effects of cold water with no exposure suit.

(9) Windchill Index (WI) is an empirical expression which evaluates the effects of air movement and air temperatures on the environment's total cooling power. FIGURE 3-3 in MIL-HDBK-759A(MI) gives values for WI as a function of wind speeds and air temperature. A WI of 1200 indicates a requirement for protection of the human.

i. Prolonged exposure of an ungloved soldier to effective temperatures below 55°F (13°C) often results in a "stiffening" of fingers, which degrades performance in tasks requiring manual dexterity.

j. A soldier wearing arctic clothing should not be exposed, while sitting quietly, to temperature higher than 60°F (16°C); a temperature of 35°F to 45°F (2°C to 7°C) is probably optimal.

Table 5.3-1. General Effects of Temperature on Human Subjects

Ambient Temperature °F	°C	Effect
160	71	Tolerable for about 1/2 hour
120	49	Tolerable for about 1 hour
85	29	Mental activities slow down, responses slow, errors begin
75	24	Physical fatigue begins
65	18	Optimum
50	10	Physical stiffness of extremities begins

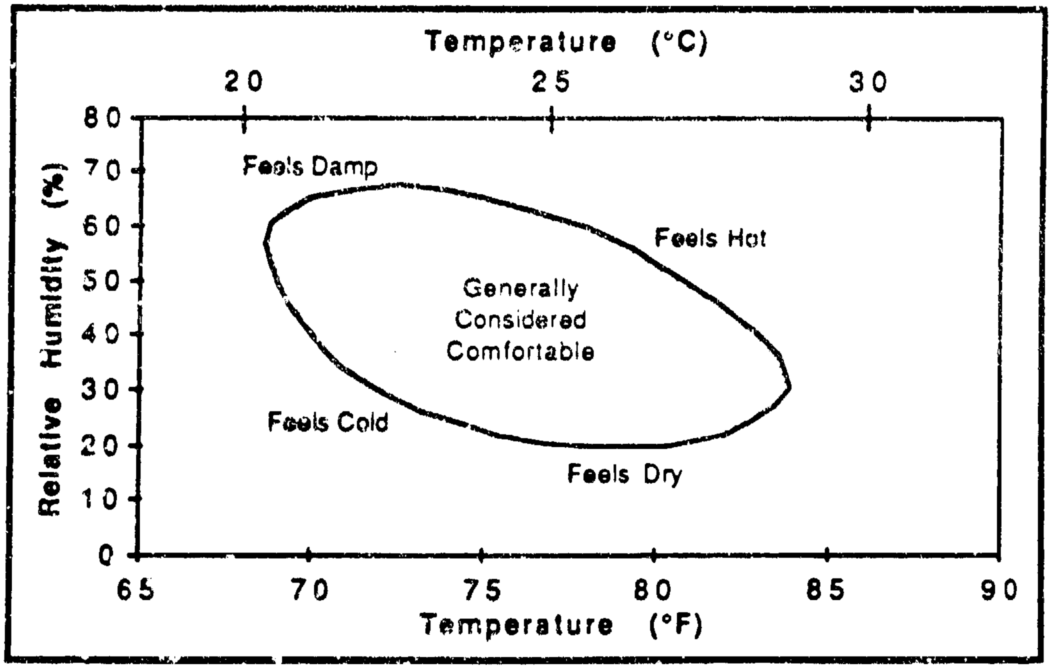

Figure 5.3-1. Comfort as a Function of Temperature and Humidity

Table 5.3-2. Comfort Range Versus Skin Temperature

Skin Temperature °F	°C	Comfort
98	36.7	Very Hot
96	35.6	Unpleasantly warm
94	34.4	Indifferently warm
93	33.9	Comfortable
91	32.8	Comfortably cool
88	31.1	Indifferently cool
86	30.0	Unpleasantly cool
84	28.9	Extremely cold

Table 5.3-3. Comfort Range Versus Hand and Foot Temperature

Hand Temperature °F	°C	Foot Temperature °F	°C	Comfort
68	20	73	23	Minimum
59-68	15-20	64-73	18-23	Tolerable
50-59	10-15	55-64	13-18	Intolerable Pain
50	10	55	13	Numbness

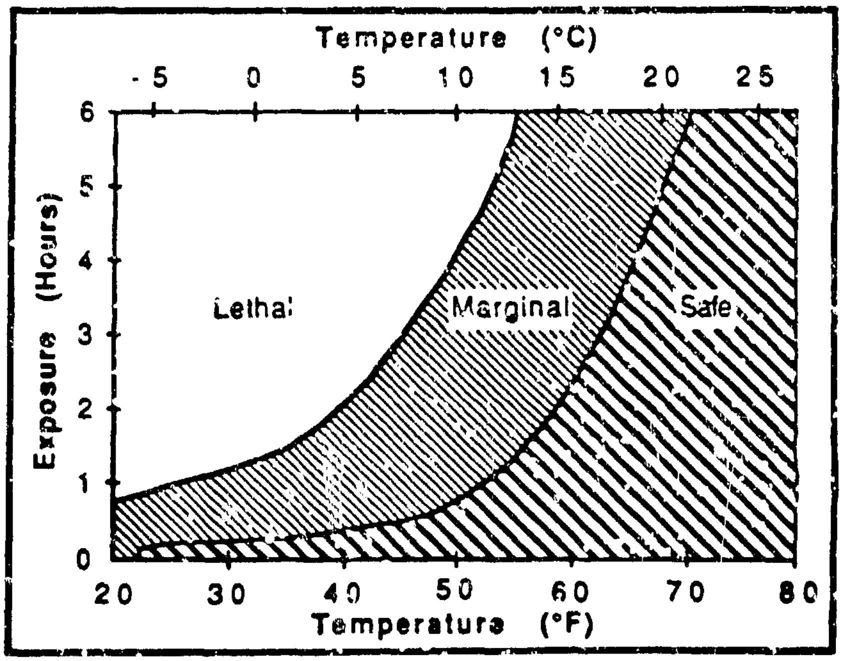

Figure 5.3-2 Life Expectancy in Cold Water

l. In cold-weather operations, crew heating is required for efficient tank operation. Owing to the great mass of steel involved in the design of most armored vehicle fighting compartments, it is doubtful whether a heater of sufficient capacity can be installed for general heating of an entire fighting compartment. Local space heating at the crew positions will normally be needed. To minimize power requirements for local space heating, the soldier will still require significant protective clothing. This also means that space must be allowed in the engineering design for the soldier with his protective clothing envelope. In addition, space heating can be minimized for well-clothed soldiers by providing auxiliary heat for the extremities.

m. Heating shall be provided within permanent and semipermanent personnel enclosures utilized for detail work or occupied for prolonged periods of time to maintain interior dry bulb temperature of 68°F (20°C).

n. There should be provisions for regulating the amount of heat the heater delivers, with devices like shutters, louvers, fan-speed controls or fuel-proof carburetors.

5.3.2.2 Surface Contact Temperature Criteria Temperature limits for unprotected skin contact with surfaces are given in paragraph 5.13.4.6 of MIL-STD-1472D. Surfaces that personnel touch such as gearshift levers, steering wheels, dash controls, seats, side panels, compartment walls, etc should have low heat conductivity.

5.3.2.3 Wet Bulb Global Temperature The Wet Bulb Global Temperature index (WBGT) is the most comprehensive measure for characterizing the effect of a heat stress environment on humans. FIGURE 5.3-3 indicates the upper limits of exposure for unimpaired mental performance (Ocupational Exposures to Hot Environments, US DHEW, HSM 72-10269). WBGT definitions and measurement procedures are contained in ISO 7243. Measures include the following:

a. Normal WBGT index using dry-bulb, wet-bulb and global temperature sensors

b. Modified WBGT index used in direct sunshine

c. Weighted WBGT which uses three sets of sensors located at the height of the head, abdomen and ankles.

d. Maximum one hour WBGT index which is the maximum value of mean WBGT recorded over any one hour period.

The following are general guidelines for application of the WBGT index (TB MED 507, p. 14):

a. When the WBGT index reaches 78°F (26°C), extremely intense physical exertion may precipitate heat exhaustion or heat stroke; therefore, caution should be taken.

b. When the WBGT index reaches 82°F (28°C), discretion should be used in planning heavy exercise for unseasoned personnel.

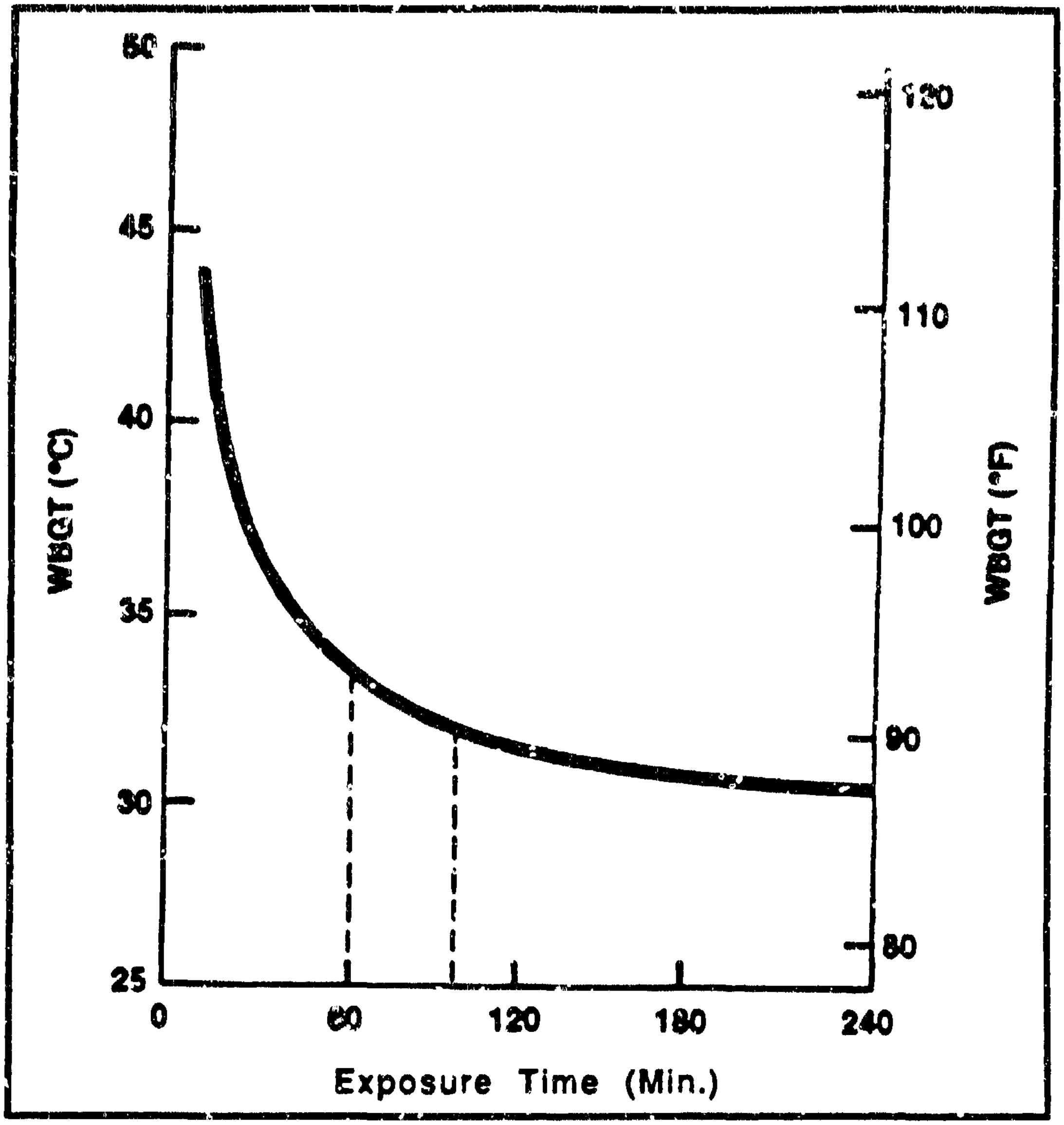

Figure 5.3-3. Upper Limits of Exposure for Unimpaired Mental Performance

c. When the WBGT reaches 85°F (29°C), strenuous exercise such as marching at standard cadence should be suspended for unseasoned personnel during their first three weeks of training. At this temperature, training activities may be continued on a reduced scale after the second week of training.

d. Outdoor classes in the sun should be avoided when the WBGT exceeds 85° (29°C).

e. When the WBGT reaches 88°F (31°C), strenuous exercise should be curtailed for all recruits and other trainees with less than 12 weeks training in hot weather. Hardened personnel, after having been acclimatized each season, can carry on limited activity at WBGT of 88°F to 90°F (31°C to 32°C) for periods not exceeding six hours a day.

f. When the WBGT index is 90°F (32°C) and above, physical training and strenuous exercise should be suspended for all personnel (excluding essential operational commitments not for training purposes, where the risk of heat casualties may be warranted).

g. Wearing of body armor or NBC warfare protective uniforms in effect adds 10°F (6°C) to the measured WBGT. Limits should be adjusted appropriately.

5.3.3 Facilities and Instrumentation

5.3.3.1 Facilities None.

5.3.3.2 Instrumentation Instruments used for temperature, humidity and ventilation measurements include thermometers, psychrometers, air velocity meters and a heat stress monitor which measures WBGT. These are listed in TABLE 2-1.

5.3.4 Method

5.3.4.1 General Guidelines While the effects of temperature on human performance and physiology are not thoroughly understood, certain extremes of temperature have been demonstrated to have detrimental effects. Moderately complex tasks without physical exertion are satisfactorily completed in relatively high temperatures. However, for increasing task complexity or for physical or mental stress, the maximum temperatures must be lowered for continued work effectiveness.

The combination of temperature, ventilation and humidity produces effects which are different than those produced by each factor individually. An evaluation of any one factor must therefore give consideration to the other factors. When temperature is measured, for example, humidity and ventilation should also be measured.

The remainder of this procedure applies to environmental measurement under conditions where the enclosure has and where it does not have provisions for varying internal temperature, humidity, and air flow. In those enclosures where controls are available for varying the environment, measurement will be conducted for the accuracy of these controls.

5.3.4.2 Selection of Conditions In planning a test of temperature, humidity and ventilation, the initial step is to identify the conditions under which the test will be accomplished. These will include:

a. Manning level - enclosure empty, minimal manning, and maximum manning.

b. Time of day or shift.

c. External temperature, humidity, wind velocity, sky cover, and ground cover (snow or ice).

The next step is to identify the measurements to be made under the selection conditions. These include:

a. Dry bulb temperature - at one location within the enclosure for approximately each five square feet of floor space.

b. Humidity at the same locations within the enclosure.

c. Air flow rate and volume at the same locations.

d. WBGT measurements at locations where heat stress is to be evaluated.

5.3.4.3 Test Setup A test stand will be used which shall be at least six feet tall and easily movable. Thermometers, humidity sensors, and air flow rate sensors will be mounted on the stand in the following manner:

a. Thermometers - at floor level and at each two foot increment in the vertical direction up to and including six feet from the floor.

b. Psychrometer - four feet above the floor level.

c. Air flow rate meters - at two and four feet.

Provisions shall be made for measuring the environmental parameters with the room empty, staffed at minimal level, and staffed at the maximum level. Tests will be scheduled to include measurements at different times of the day and shift, and with varying external temperature and humidity levels.

For the control accuracy measurement, a set of temperature and ventilation levels is pre-selected. The temperature and ventilation levels are manipulated to the selected levels, and measurements are made of the degree to which resultant enclosure temperature and ventilation match the control values and of the time lag incurred in reaching these levels.

5.3.4.4 Test Conduct Temperature, humidity, and ventilation will be measured under the following conditions:

a. For every five square feet of enclosure floor space there should be a test stand mounted with instruments as described above.

b. Measurements are made prior to the start of workday or shift, and then at four hour intervals into the shift. Measurements are also to be made at four discrete times of day: dawn, noon, dusk, and midnight.

c. Measurements are made with the enclosure empty, minimally manned, and maximally manned.

d. Measurements are made under varying conditions of external temperature, humidity, wind velocity, snow and ice, measured at each of the four sides of the enclosure or on those sides which face the external environment. (This will apply only to large enclosures. For tents and vehicle cabs only one external measurement location is necessary.)

e. Air flow volume measurements are made at the duct. The duct opening should be divided into small grids, and a measure of air velocity made at each grid section with a hot wire anemometer. The measurement should be averaged and substituted in the following formula:

Flow volume (cu. ft./min.) = Velocity (ft./min.) X Duct Area (sq. ft.)

For multiple duct enclosures, the quantity of air for each duct should be summed.

f. Surface temperature should be measured where there exists a potential for soldier contact with hot surfaces. A surface temperature probe should be used to measure at least five spots that are equal distance on the surface. The temperatures should be averaged. Specific hot spots should be noted.

g. Where heat stress is anticipated, WBGT measures will be taken including the normal and modified WBGT indexes, the weighted WBGT index using head-, abdomen- and ankle-height sensors, and the maximum one hour WBGT index as appropriate.

Specified temperatures and air flow rates are sequentially selected via heat, air conditioning, and blower controls. After a period of thirty minutes, measures of temperature, humidity, and air flow rate will be made under conditions and procedures as described above.

5.3.5 Data Required

5.3.5.1 Environmental Measures Mean values of dry-bulb air temperature, humidity, and air flow rate will be computed for each manning condition, each time of day and shift, each external environment condition, and each vertical and horizontal location independently. Touch surface dry-bulb temperatures and WBGT measures will be reported where these are appropriate. The mean values should be compared with the criteria described in paragraph 5.3.2.

5.3.5.1 Control Accuracy Measures Data for the assessment of environmental Control Accuracy include the control settings used, the resulting temperatures and air flow rates/volumes, and the time interval required to reach these levels

5.3.6 Data Reduction and Presentation The data shall be compiled and separated into two categories. One category shall be Environmental Measurements and the other Control Accuracy Measurements. Within each category exist specific comparisons by degrees, percentages, and rates between criteria established and measurements taken.

Those measures which fall outside of limits prescribed by the criteria listed in paragraph 5.3.2 should be tabulated separately under a discrepancy list.

In addition to measurements that can be compared to specific criteria with quantitative limits, there may exist data for which there are no minimums and maximums established. This material should be assessed, where applicable, with reference to information provided in the latter portion of paragraph 5.3.2 (sub-paragraphs (1) through (9)). Where such comparisons can be made, those areas that do not meet desired standards should be added to the discrepancy list.

The discrepancy list should be reviewed and recommendations made for each problem encountered. The data should be presented in tabular form.

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5.4 TEST PROCEDURE - VISIBILITY MEASUREMENT

5.4.1 Objective The purpose of this test procedure is to describe test methods and measurements for assessing visibility (other than lighting) from or within a test item. The factors influencing visibility include field of view (unobstructed), distance to and orientation of components requiring visibility, and viewing media (fog, rain, clear air, glass, icing on glass, blowing snow, ice fog).

5.4.2 Criteria

5.4.2.1 Visual Angles

a. A vehicle driver shall have a 180° (3.14 rad) field of view forward (±90° (1.6 rad) from the centerline).

b. A truck driver should be able to see the road at a point 10 ft. (3 m) in front of the vehicle. Upward visibility shall extend at least to 15° (0.3 rad) above the horizontal.

c. Maximum eye rotation without head movement is 40° (0.7 rad) up, 20° (0.35 rad) down, and ± 35° (0.6 rad) laterally.

d. Maximum head rotation is 100° (1.75 rad) up-down, and 120° (2.1 rad) right-left.

e. Maximum eye and head rotation is 90° (1.6 rad) up and down, ± 95° (1.7 rad) laterally.

f. Aircraft personnel shall have a field of view as defined in MIL-STD-850B

Additional criteria and methods for measurement of the field of view from vehicles are provided in TOP 3-2-812.

5.4.2.2 Eyepiece Components The radii of Figure 49 in MIL-STD-1472D defines a surface of revolution within which a satisfactory symmetrical eyepiece and cup must be designed if interfaces with facial features are to be avoided.

5.4.3 Facilities and Instrumentation

5.4.3.1 Facilities To adequately determine visibility outside a vehicle, a hard-surfaced area is necessary to measure visual angles and distances. Ideally, this area should have a grid overlaid on the surface to use for measurement reference points.

5.4.3.2 Instrumentation

a. Measuring tape - 100 ft.

b. Surveyor's transit

c. Surveyor's level rod.

5.4.4 Methods

5.4.4.1 General Guidelines Visibility measurements should be required whenever an item user must: view through windows, port holes, periscopes, etc., associated with the item; visually acquire and recognize components of the item; read displays and labels mounted in or on the item; use optical devices associated with the item.

5.4.4.2 Selection of Conditions

a. Test participants shall be representative of the 5th to 95th percentile in: eye to seat height for seated operations; or eye height for standing operations. Participants shall be screened for visual anomalies and classified in the normal range (corrected or uncorrected) in visual acuity, depth perception, color vision, and phoria.

b. Some test participants should be wearing eyeglasses for situations where glare is an expected problem.

c. Test participant clothing should be representative of use to the extent that such clothing can influence the specific test (effects of helmet on visual envelope, etc.).

d. Representative item operations will be used to the extent that they could require a configuration of the item or item components which could affect visibility.

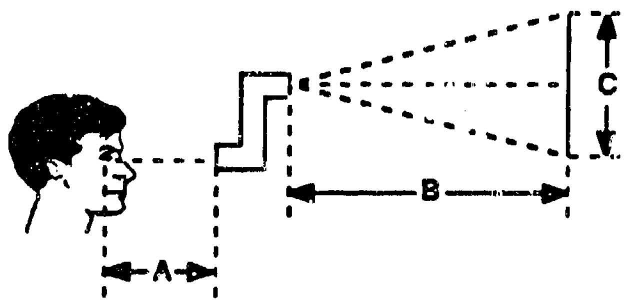
5.4.4.3 Test Setup Identify item components which restrict visual angles (windows, accesses, mirrors, etc.). Acquire criteria data on required angles if available. If visibility outside a test item is to be assessed, the test item should be placed on a flat, hard surface area. TOP 3-2-812 describes procedures for determination of fields of vision from vehicles.

Select components to be visually acquired and identified in the test. Consideration should be given to components (controls, displays, labels, test points, etc.) which appear to be partially or totally hidden at all times or under certain item configurations, and which are required to be visible to the participant. The HFE specialist should consider maintenance activities as well as normal operating procedures for the selection of components. If ambient light is identified as a factor influencing user performance, a range of light levels shall be established to cover the range of representative lighting conditions.

Select target displays and labels which appear to present a problem for reading in terms of display or label location, size, shape, orientation, lighting, scaling, or arrangement with other displays and labels, and in terms of participant size and clothing conditions. Select display illumination levels to cover the range available under different and representative levels of ambient light. Table III in MIL-STD-1472D details mechanical display applications. The Design Checklists for Labels, Manuals & Markings and for Displays provided in Appendix B of HEDGE should be consulted to identify visibility/reading requirements and these should be considered in selecting visibility/reading targets.

5.4.4.4 Test Conduct

5.4.4.4.1 Visual Angles Determine visual angles by measuring the dimensions of the window, access, or mirror, and the distance to the eye. For viewing blocks, perform the measurements as illustrated in FIGURE 5.4-1. Visual angles of displays, controls, and cockpits of aircraft can also be measured by using a surveyor's transit placed at the design eye height for the 5th and 95th percentile personnel.



Vertical Viewing Angle Through Vision Blocks					
Viewing Position	Viewer Percentile	Eye to Block Distance A	Block to Vertical Scale B	Maximum Viewing Angle C	Remarks

Figure 5.4-1. Sample Form for Measurement of Viewing Angles Through Vision Blocks

5.4.4.4.2 Interior Visibility Test participants are placed at the work station in the normal operating position and are asked to find specific displays or labels. No familiarization or training on display/label location should be given to offset memory effects, and all participants should begin the test at the same general level of familiarity with the item. The HFE specialist starts a timer or stop watch with the command to find a display, and stops the timer when the display or label has been located.

Test participants in the prescribed work station are requested to read labels and display values or nomenclature for labels and displays indicated to them by the The HFE specialist. The The HFE specialist measures the time from command to the correct response.

5.4.4.4.3 Exterior Visibility Evaluate optics and glass windows, etc. (If applicable) by having subjects view through them. Vary internal illumination from minimum to investigate potential glare effects of the media.

Evaluate fields of view from vehicles by plotting visibility contour maps using a data collection form similar to that provided in Appendix A of Part I. (See TOP 3-2-812). The test object should be placed so that the operator position is at the center of the circle. Using a surveyor's level rod or similar device, the The HFE specialist should determine where the visibility contour lies for the 5th and 95th percentile soldier. Sample visibility contour maps are presented in FIGURE 5.4-2.

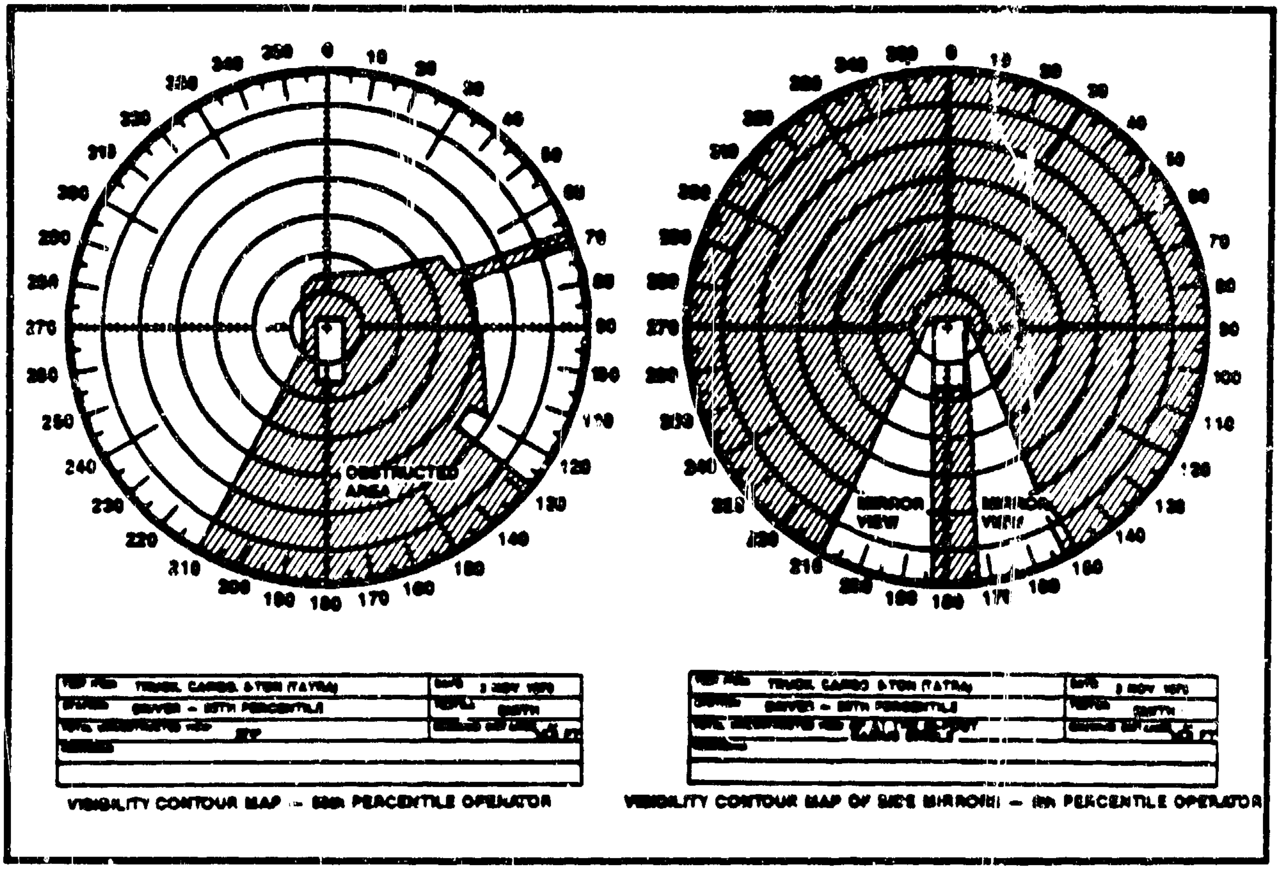


Figure 5.4-2. Sample Visibility Contour Maps

5.4.5 Data Required

5.4.5.1 Visual Angles Record the dimensions of the visual angles of the window, access, mirror, display, control, windshields.

5.4.5.2 Internal Visibility Record time to access and accuracy of finding components; record time to read and accuracy of reading labels.

5.4.5.3 External Visibility Record visibility contour maps.

5.4.6 Data Reduction and Presentation

5.4.6.1 Visual Angles Compare obtained visual angles with criteria provided in paragraph 5.4.2.1. Depict angles pictorially (both obtained angles and criteria).

5.4.6.2 Internal Visibility

a. For visual location of components, compute probability of component visual access as function of time - for 5th percentile and 95th percentile participants. Determine if body size affects visibility of components. Identify problem areas, including:

(1) Insufficient illumination or glare.

(2) Obstructed vision.

(3) Poor component location.

Present data pictorially or graphically, as applicable.

b. For display and/or label reading, compute probability of correct display reading as a function of time for 5th and 95th percentile participants. Determine if body size affects display reading capability. Identify problem areas including:

(1) Insufficient illumination or glare.

(2) Inappropriate orientation of display/label to the viewer.

(3) Inappropriate location of display/label.

(4) Inadequate scaling or character size.

Present data in tabular form.

c. For eyepiece components, the radii of the eyepiece components (Figure 49 in MIL-STD-1472D) should be applied to cushion forms when they are compressed to the maximum. These data should be presented pictorially.

5.4.6.3 External Visibility Compare obtained visibility contours to the criteria in paragraph 5.4.2.1 and the IAP, IEP or TDP. Depict the visibility contours on visibility contour maps.

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5.5 TEST PROCEDURE - SPEECH INTELLIGIBILITY

5.5.1 Objective The purpose of this procedure is to describe test methods and measures for assessment of speech intelligibility associated with voice communication equipment, accessories, end instruments, and ancillary equipment such as:

a. Radio sets - fixed, portable, and mobile (AM, FM, and SSB).

b. Radio - wire integration equipment.

c. Communication security equipment.

d. Telephone sets.

e. Megaphones - electronic.

f. Public address systems.

5.5.2 Criteria Auditory presentation factors for tones and complex sounds, as well as speech, which should be used are given in TABLE V in MIL-STD-1472D. The types of signals which shall not be used because of possible confusion in the operational environment are noted in paragraph 5.3.4.3.6 of MIL-STD-1472D. Criteria and methods are also provided in TOP 6-2-521. The intelligibility criteria provided in paragraph 5.3.12 and TABLE VI in MIL-STD-1472D shall be used for voice communication. The efficiency of communications needed, and the type of material to be transmitted shall determine which of the three communication requirements of TABLE VI is to be selected. Speech intelligibility measures include the following:

a. The Phonetically balanced (PB) word intelligibility test (ANSI S3.2) requires a talker and listener. Single words are spoken and are reported by the listener. Speech intelligibility is measured based on listener performance.

b. Modified Rhyme Tests (MRT) require a talker and listener. Single words are spoken in a carrier sentence and the listener indicates the word on a multiple-choice form which includes rhyming confusion words. Speech intelligibility is measured based on listener performance.

c. The Articulation Index (AI) does not use talkers or listeners. Speech intelligibility is predicted by obtaining octave band noise measurements and applying a formula. FIGURE B-18 in MIL-HDBK-759A(MI) shows the relationship between the AI and the intelligibility of various types of speech-test materials

Advantages and disadvantages of the speech intelligibility measures are discussed in paragraph 5.5.4.4.

5.5.3 Facilities and Instrumentation

5.5.3.1 Facilities

a. Test range for ground wave or line-of-sight propagation radio equipment.

b. Appropriate test sites for intermediate and long range sky wave propagation radio equipment.

c. Test range for wire and/or cable communication equipment.

d. Test range for public address type equipment.

e. Appropriate communication system for test control.

f. Appropriately equipped maintenance shop van to support outlying test stations.

g. Appropriately equipped repair facility to support base station.

5.5.3.2 Instrumentation

a. Sound level meter with octave band filter set as described in TABLE 2-1 and section 5.2.

b. Voice channel noise measuring set.

c. High fidelity audio tape recorder-reproducer and micropnone.

d. High fidelity loudspeaker-amplifier for use with audio tape recorder-reproducer, if required.

5.5.4 Method The methods described here for assessment of an item for its effect on speech intelligibility require the use of test participants as listeners and talkers. The general approach involves having selected talkers verbally present standardized words or sentences which listeners hear and record. The adequacy of the communications equipment is determined by computing the percentage of messages correctly received and recorded. Noise measurements and calculation of the Articulation Index does not require test participants. This method is carried out by applying noise measurement techniques described in section 5.2 to the communications channel. The raw data are then analyzed as described in ANSI S3.5, in section B.1.1.5.3 of MIL-HDBK-759A(MI), and in Chapter 5 of Van Cott and Kinkade (1972).

5.5.4.1 General Guidelines An underlying philosophy of this procedure is to eliminate from consideration those variables affecting speech intelligibility which are not related to the equipment being tested.

In tests of communications equipment, it is important that the content of the message not be a variable factor in speech intelligibility tests. Therefore, over repeated test periods, messages are used that are of equal difficulty to comprehend. Because of possible learning effects the same messages should not be repeated to the same operators.

Consequently, the lists chosen for this procedure have nearly the same phonetic composition. Rare and unfamiliar words have been avoided as much as possible. The speech sounds used are representative of conversational speech. The various speech units are balanced and lists are approximately equal in difficulty.

5.5.4.2 Test Planning Conduct a thorough study of the requirements documents, contract specifications and test directives to ensure that complete and suitable speech intelligibility test criteria are selected. Study thoroughly the item(s) being tested to include operational and technical characteristics pertinent to speech intelligibility.

In order to preclude the use of an individual with abnormal hearing or speech who might have an impact on test results, all test participants must be screened for hearing or speech disorders. Each test participant must have a hearing test administered by a qualified technician at a health clinic. Personnel must have Class A hearing (no significant hearing handicap) in the better ear. TABLE B-3 in MIL-HDBK-759A(MI) shows Class A hearing to be the ability to hear a sound less than 25 dB at 500, 1000, and 2000 Hz in the better ear. Additionally, test participants must be given a baseline speech discrimination test using a phonetically balanced word list or modified rhyme

test list to assure that all test participants possess normal speech intelligibility (95-100 percent at a sound level 40 dB above the Speech Reception Threshold (SRT)).

5.5.4.3 Test Setup The test equipment, which may be radio, wire, or PA will be set up to perform its intended function.

The setup for testing will be in a typical field environment using personnel selected from individuals representative of those who will operate the equipment if it is fielded. Procedures for setting up this equipment follow:

a. Radio Links Use appropriate portions of TOP 6-2-242 or TOP 6-2-246 to establish a point-to-point or multi-station communication network utilizing equipment being tested. Test sites must be selected close enough to one another to insure optimum signal strength. Care must be taken to ensure that receivers and transmitters are not located in such proximity to overload the receiver or cause co-location interference. Ground wave communication may be used for skywave equipment. Particular attention must be given to frequency selection. Refer to appropriate instructions for listing of frequencies authorized for use in the organization controlling the test site. Listing indicates maximum power which may be used and modes of modulation which are authorized. If the High Frequency (HF) Band (3-30 MHz) is used, proper frequencies must be determined by the use of propagation charts or by requesting assistance from the Communication Engineering Directorate of the U. S. Army Strategic Communication Command. If frequencies are required which are not already authorized, the testing agency must originate a request for these frequencies in accordance with AR 105-24. Before test messages are exchanged, the selected frequency must be monitored at all net stations to assure that it is clear for test usage. Procedural messages will then be exchanged to insure that signal-to-noise ratio is satisfactory for the conduct of the test.

b. Wire Links Utilizing the equipment/component being tested, along with other telephone equipment (switch-boards, telephone terminals, cable, wire, telephone sets) with which the test item is designed for use, establish a wire communication network. Assure that wire and/or cable lengths do not exceed design parameters. Determine that crosstalk and/or channel noise will not significantly affect voice transmissions.

c. Audio Equipment After the system is set up according to the technical manual, it should be checked to assure that no aspect of improper operation exists such as pickup or feedback.

The equipment must be adjusted and aligned in accordance with the appropriate technical manuals to assure minimum distortion and signal loss between the speech source and the listener. The speech source may be a qualified talker or a tape recording (professional standard test recording or a recording generated by qualified talkers).

A thorough practice period with the test item must precede the formal testing in order to fully familiarize test personnel with the test item and the test procedures. Practice should be continued until the learning period is over and the speech intelligibility scores of test participants reach a plateau. Scores should be given to test participants so that they are aware of their improvement and so that motivation and interest is maintained.

5.5.4.4 Test Conduct The HFE specialist will select messages composed of Phonetically Balanced Word Lists from Appendix C-1 of Part I or word lists from the Modified Rhyme Test Lists in Appendix C-2 of Part I. The list chosen shall be used consistently throughout the test so that scores obtained are not a mixture of various types of tests. To assist in the selection of the proper list, a discussion of the advantages and disadvantages of each follows:

a. Use of the Phonetically Balanced Word Lists has several advantages:

(1) Available lists cover a wide range of difficulty.

(2) The spread of difficulty is approximately equal from one list to the next (average difficulty is about the same)

(3) The speech sounds represented by the words are balanced phonetically - controlling a variable whose influence on test scores is extremely difficult to determine. However, a disadvantage is that carrier phrases must be used (Number "xx", you will mark "xx" now.). This redundancy and lack of real life context sometimes causes boredom to the extent that performance levels are affected.

b. Modified Rhyme Tests have the advantages of not requiring much practice and that errors cannot result from misspelling the words when reporting. However, this test assesses only the intelligibility of the front or end consonants of a word and does not test the intermediate vowel sound.

When conducting a modified rhyme test the HFE specialist needs to ensure that talker and listener sheets in the test packet are in the proper order. A sample talker's sheet is shown in TABLE 5.5-1. Before speaking the talker should begin with:

This is "xxx" reading list "xxx" from the "xxx" position.

Each word on the talker sheet must be read with the following carrier sentence:

Number "xx", you will mark "xx" now.

The number is that shown in TABLE 5.5-1 and the word to be marked is the one associated with the number. Listeners respond by checking the word they judge to have been transmitted on a listener' check sheet as shown in TABLE 5.5-2. There should be about five seconds between carrier sentences. After each test participant has spoken from his or her position and listeners have completed listener's sheets, the completed listener's sheets are given to the HFE specialist administering the test. Test participants then rotate to new positions. The test continues until each test participant has talked and listened from each position.

Messages will be read by qualified talkers or a tape recording of a qualified talker will be played through the system and qualified listeners will record the messages as they hear them or will check a word on a listener's check sheet. When possible, more than one listener may be employed at the listening station. The use of multiple listeners may not be possible when the listening device is a headphone set or telephone.

Table 5.5-1. Sample Talker's Sheet for Modified Rhyme Test

Modified Rhyme Test								Form ID	
1	tick	11	sale	21	pat	31	pin	41	came
2	feat	12	peak	22	did	32	seed	42	boil
3	pup	13	king	23	kit	33	gay	43	fib
4	book	14	sag	24	tin	34	test	44	cud
5	lip	15	sip	25	tier	35	pave	45	keel
6	rate	16	told	26	bent	36	bath	46	lark
7	bang	17	bun	27	sun	37	pop	47	heave
8	fill	18	lake	28	shed	38	pig	48	den
9	mass	19	gun	29	pot	39	tan	49	saw
10	tale	20	bust	30	duck	40	cape	50	beat

Listeners and talkers must be rotated between test samples so that a test sample, listener, or talker does not unduly bias the test. Also, as mentioned above, an important factor in speech intelligibility testing is the participant's motivation. Care must be taken by the HFE specialist to assure that boredom and fatigue do not create bias in the data.

The HFE specialist will provide a schedule including the order of stations to be used for transmitting and receiving, the talkers (or tape recording) and listeners to be used, and the messages to be transmitted. He/she will assure that the stations are manned with the proper qualified talkers and listeners.

After procedural messages have been exchanged, the designated talker will transmit the designated test message in a clear, strong voice, spacing the characters/words to allow a five second interval between monosyllabic words. If the transmitted messages are not tape recordings, they should be recorded at the transmitting station for subsequent comparison with received messages, in order to eliminate from the assessment those errors made by the talkers.

Listeners at the receiving net stations will manually transcribe all test messages or mark an appropriate response on a listener's check sheet. Listeners should be required to add any appropriate comments relative to characters/words that may be missed or about which they are uncertain.

Sufficient log entries will be made at all stations to fully identify each test message. Transmissions will be recorded at the receiving station for comparison with recordings made at the transmitting station in order to assess the quality of the communications equipment being tested.

Each test message, consisting of a complete word or sentence manually transcribed by the listeners, or a listener's check sheet will be scored to determine the speech intelligibility percentage for that message.

Sufficient test messages (approximately 100) should be transmitted to give a high degree of confidence in the results. These messages should be equally distributed among the listeners, who should number approximately 20 but in no case less than five.

Table 5.5-2. Sample Listeners Check Sheet for Modified Rhyme Test

Listener, Position, Set ______________________
Talker, Position, Set ______________________
Noise Source ______________ Date, Time ______________
Condition ______________ Talker's Form No. ______________

1	lick	pick	sick	20	bust	dust	rust	39	tam	tang	tan
	pick	tick	wick		just	gust	must		tack	tab	tap
2	feat	heat	neat	21	pack	pan	pass	40	cane	cake	cape
	seat	meat	beat		path	pat	pad		case	came	cave
3	pup	puff	pus	22	did	dig	dip	41	came	game	fame
	puck	pun	pub		din	dill	dim		tame	same	name
4	hook	took	look	23	bit	hit	kit	42	oil	soil	toil
	book	cook	shook		wit	fit	sit		foil	coil	boil
5	hip	lip	rip	24	tin	win	din	43	fit	fizz	fin
	sip	dip	tip		sin	pin	fin		fill	fig	fib
6	rate	race	rave	25	teal	tear	tease	44	cuss	cut	cuff
	ray	raze	rake		team	teak	teach		cup	cub	cud
7	gang	hang	sang	26	tent	sent	bent	45	peel	heel	eel
	bang	fang	rang		rent	went	dent		feel	keel	reel
8	will	till	hill	27	sun	sub	sum	46	bark	hark	park
	fill	kill	bill		sud	sup	sung		dark	lark	mark
9	mat	mass	mad	28	wed	red	bed	47	heal	heap	heat
	map	math	man		shed	fed	led		heave	heath	hear
10	gale	pale	tale	29	hot	tot	not	48	then	men	ten
	male	sale	bale		pot	lot	got		hen	den	pen
11	sake	sale	safe	30	dun	duck	dub	49	saw	raw	jaw
	sane	save	same		dug	dud	dung		law	paw	thaw
12	peace	peat	peak	31	pin	pip	pig	50	beam	beat	bead
	peas	peal	peach		pit	pill	pick		bean	beak	beach
13	kick	kid	kit	32	seep	seem	seethe				
	kill	kin	king		seen	seed	seek				
14	sack	sag	sass	33	may	pay	way				
	sap	sat	sad		day	say	gay				
15	sip	sit	sin	34	best	vest	rest				
	sick	sill	sing		nest	test	west				
16	sold	cold	told	35	pane	page	pale				
	gold	hold	fold		pave	pace	pay		Scorer ______		
17	bun	bus	buff	36	bat	bath	bad				
	bug	but	buck		ban	back	bash		Form ______		
18	late	lace	lay	37	pop	shop	mop				
	lane	lake	lame		cop	hop	top		Score ______		
19	bun	nun	sun	38	dig	rig	big				
	run	fun	gun		pig	wig	fig				

5.5.5 **Data Required** Record applicable elements of the following data:

a. List of equipment used including serial numbers and most recent calibration dates.

b. List of test participants including names, rank, MOS, unit, and results of speech, hearing, and speech intelligibility preliminary screening tests.

c. Transcripts of transmitted and received messages with the date, time, talker, listener, test setup (include all components and serial numbers, frequencies and modes used, locations, etc.), and speech intelligibility score annotated.

d. Location and description of test site (including for example: elevation, type, height, and orientation of antennas).

e. List of frequencies required for test.

f. List of available/authorized frequencies and any limitations on their use for the test.

g. List of frequencies selected for use and any evidence of interference on these frequencies.

h. Results of exchange of procedural messages.

i. Signal strength measurements.

j. Channel noise measurements.

k. Signal plus noise measurements.

l. Description and measurements of ambient acoustic noise.

m. Channel (or path) used if multi-channel or switched communications net.

n. Selected test messages on magnetic tape at transmitting and receiving stations. (See TABLE 5.5-1.)

o. Comments of listeners relative to test message talkers and missed characters/words. (See TABLE 5.5-2.)

p. Block diagrams of test setups showing test items, all instrumentation, and locations of talking and listening stations.

q. Ambient temperature, humidity, and wind-chill.

r. Head covering and/or ear protective equipment used.

s. Speed of wheeled or tracked vehicle used during test. (Note: Moving vehicles need to be operated at two-thirds of the maximum speed in the highest gear during test conduct.)

5.5.6 **Data Reduction and Presentation** Speech intelligibility of each received complete list will be computed by dividing the number of correctly interpreted words by the total number of words in the complete list. Modified rhyme test results will be scored by counting the number of words correctly reported by the listener and then correcting this for guessing using the following formula

$$\text{Percent Correct} = \left[\text{No. Correct} - \frac{\text{No. Wrong}}{5}\right] \times 2$$

For example, if a listener reported 46 words correctly and 4 incorrectly then the Percent Correct score would be (46 - 4/5) x 2 = 90.4 percent

Calculations will be performed to provide the median, mean, and standard deviation of the speech intelligibility scores across test participants.

Message scores will be reviewed to determine if the scores of any one test sample or individual talker or listener were markedly different from the majority of the scores and to identify any consistent speech intelligibility areas such as consistently poor intelligibility of the same speech sounds.

The average speech intelligibility should be approximately equal to or greater than the required percentage to consider the requirement met. Standards will be derived from requirements and contract specifications. If no specific intelligibility criteria are provided, test scores for each tested position should be compared to the intelligibility criteria for voice communications systems in TABLE VI in MIL-STD-1472D. Data will be presented in tabular form.

5.6 TEST PROCEDURE - WORKSPACE AND ANTHROPOMETRICS

5.6.1 Objective The purpose of this test procedure is to describe the methods and measures for evaluating the adequacy of workspace in order to ensure that the item being tested can accommodate operators and maintainers with regard to their physical characteristics.

5.6.2 Criteria Design criteria which involve dimensions of workspace are based on anthropometric data on human body dimensions. The general principle is that workspace, access openings, etc. should accommodate a considerable range of body sizes. In general, this range is taken to be that from the 5th percentile for females to the 95th percentile for males. In some cases, equipment is intended for use by males only and the corresponding range is that from the 5th to the 95th percentiles for males. These percentile values as well as other body dimension statistics such as means and standard deviations are determined through anthropometric measurements taken on large samples from selected populations. Ranges of anthropometric data are used to define design criteria for workspace dimensions. For example, functional reach data as shown in FIGURE 23 and TABLE XIII in MIL-STD-1472D are used to establish the maximum distance of a vertical panel section from a standing operator position.

5.6.2.1 Workspace Design Criteria Selected anthropometric data are provided in section 5.6 of MIL-STD-1472D. Design criteria for workspace dimensions are provided in section 5.7 of MIL-STD-1472D. These criteria address workspaces and operator positions which are common to many test items. These include standing operation at consoles, seated operation at consoles and other selected working positions. Access, clearance and workspace design criteria in the area of design for maintenance are covered in section 5.9 of MIL-STD-1472D. In particular, the HFE specialist should review FIGURES 29, 30, 31, 32, 33, 34, 35, 36, 37, 45, 46, 48, 50, and 51 and TABLES XIX, XX, XXIV, and XXVII in MIL-STD-1472D to identify workspace dimension criteria.

5.6.2.2 Other Anthropomentric Data and Workspace Design Recommendations The workspace design criteria in MIL-STD-1472D address a number of common operator working positions. A certain test item, however, may require body positions for access, egress, work at the worksite, etc. which are not covered by MIL-STD-1472D. In these cases, it will be necessary to characterize, sketch, photograph, etc. the required body position and orientation and to use anthropometric data directly to assess the suitability of the dimensions of the test item. In addition to the anthropometric data contained in MIL-STD-1472D, other sources of these data are DOD-HDBK-743, MIL-HDBK-759A(MI), Chapter 11 of Van Cott and Kinkade (1972), and Gordon et. al. (1989). The Gordon et. al. data are of particular importance because they contain the most recent measurements. For mobile operations that require stooping, squatting, kneeling, crawling, or prone positions, dimensions presented in FIGURE 2-32 and TABLE 2-17 in MIL-HDBK-759A(MI) shall apply. For aircrew station geometry, the HFE specialist should also refer to MIL-STD-1333A. Criteria and methods for evaluation of equipment stowage provisions are contained in TOP 2-2-802.

5.6.2.3 Protective Clothing Many of the anthropometric dimensions referred to above are taken from nude subjects and are applicable when light clothing is worn. Use of protective garments such as arctic clothing, however, may considerably reduce mobility and functional reach while increasing the required access dimensions. Recommended clearances at a seated operator station to accommodate use of arctic clothing are provided in FIGURE 51 and TABLE XXVII in MIL-STD-1472D. Mobile workspace dimensions for arctic clothed personnel are contained in FIGURE 2-32 and TABLE 2-17 in MIL-HDBK-

759A(MI). Arm and hand access requirements in arctic clothing are contained in FIGURE 45 in MIL-STD-1472D. Whole body access dimensions while wearing bulky clothing are contained in FIGURE 37 in MIL-STD-1472D. Minimum handle dimensions with mittened hand are presented in FIGURE 48 in MIL-STD-1472D. Anthropometric dimensions with various types of clothing including arctic gear and helmets are addressed in section 2.2.4.2 in MIL-HDBK-759A(MI). TABLE 5.6-1 presents reach capabilities at various arm angles under the conditions of winter clothing and pressure suit from Alexander, et. al. (1976).

Table 5.6-1. Fifth Percentile Arm Reach Capability Expressed as a Percentage of the Shirt Sleeves Condition for Winter Clothing and Pressure Suited Conditions

Arm Angle	Winter Clothing	Pressure Suit
Right 0° (front) or Left	75%	72%
Right 30° (0.5 rad)	82%	75%
Left 30° (.5 rad)	82%	63%
Right 60° (1.0 rad)	87%	78%
Left 60° (1.0 rad)	86%	78%
Right 90° (1.6 rad)	88%	83%
Left 90° (1.6 rad)	91%	82%
All measurements made 24 in. (61 cm) above the deck		

5.6.3 Facilities and Instrumentation

5.6.3.1 Facilities None.

5.6.3.2 Instrumentation Instrumentation for anthropometric measurements includes an anthropometer with attachments for various body dimension measurements and a weight scale as listed in TABLE 2-1.

5.6.4 Method Workspace must be compatible with the anthropometric dimensions of the users of the equipment. The limits of anthropometric data, such as body dimensions and reach, are expressed in terms of 5th and 95th percentile measurements as described in paragraph 5.6.2. These points represent the two extreme limits of the population which it is reasonable to expect an item to accommodate. Clothing appropriate to accomplish item tasks and representative clothing worn during item operation/ maintenance must also be considered. This clothing, in some instances, adds significantly to clearance requirements. The primary interest in cold regions evaluation of workspace is the effect of the full arctic uniform on clearance and reach.

5.6.4.1 General Guidelines The general approach involves selecting body dimensions to be considered and selecting test participants classified as 5th and 95th percentile male and female as appropriate on the applicable dimensions. These participants then perform required activities using the test item under representative operation, maintenance and clothing conditions. Where problems are noted in conducting specific tasks, measurements will be made to determine the causes of the problems.

5.6.4.2 Selection of Conditions

a. Test participants representative of the 5th to 95th percentiles in specific and appropriate physical characteristics should be selected. If it is necessary to determine 5th and 95th percentiles of body dimensions, use the procedures contained in DOD-HDBK-743.

b. Clothing should be worn consistent with the most extreme weather conditions under which the item may be expected to operate or be used.

c. The full range of operator/maintainer activities should be addressed - including such tasks as adjusting seats, mirrors, belts, etc. Sample Task Checklists are provided in Appendix A of HEDGE. These should be reviewed in identifying item specific tasks which could be affected by anthropometric and workspace dimension considerations.

d. Seated eye-height measurement may be reduced by as much as 2.5 inches when personnel sit in a relaxed manner. The natural position should be considered in seating requirements but should not be used as a justification of inadequate clearance.

e. Minimum and maximum dimensions of certain workspaces are called out in MIL-STD-1472D as described in paragraph 5.6.2.1 above. Where these design criteria are applicable to a test item, the necessary dimensional measurements should be completed first since test participants are not needed. After these requirements have been met, concentration can then be directed to observing difficulties encountered by test participants.

5.6.4.3 Test Setup

a. Assess the test item with respect to clearance limits for components such as hatches, accesses, and safety exits, and make plans for their use to ensure proper passage for appropriately clothed 95th percentile participants.

b. Assess item for reach distances which involve the extension of body parts insuring the accommodation of 5th percentile personnel, especially as constrained by bulky arctic clothing.

c. Ensure that information on operation/maintenance of the item is available and transcribed into a checklist so that a full range of activities is completed.

5.6.4.4 Test Conduct From the list of tasks that are required to conduct the test, a checklist should be constructed of those tasks in which body parts play a functional role. From this list, tasks should be checked off which are covered by workspace design criteria described in paragraph 5.6.2.1. Performance of the remaining tasks should be observed and difficulties recorded. If personnel are not available with 5th and 95th percentile dimensions, extrapolations should be made to the ability of the 5th and 95th percentile personnel to perform the tasks. Design characteristics of the workspace

should be assessed using the Workspace Design Checklist provided in Appendix B of HEDGE.

5.6.5 Data Required Record the following data:

a. Dimensions of all workspaces that conform to workspace dimension criteria described in paragraph 5.6.2.1.

b. Anthropometric measurements of dimensions of test participants who best represent the male and female 5th and 95th percentiles.

c. List of difficulties encountered due to workspace dimensions by each participant in the performance of assigned tasks.

d. With each difficulty encountered, measurement of relevant dimensions of the specific workspace involved and the dimensions of the affected body parts of the 5th and 95th percentile personnel involved, including extrapolations where necessary.

5.6.6 Data Reduction and Presentation Measured dimensions of workspaces which are subject to the design criteria referenced in paragraph 5.6.2.1 should be compared with the applicable design criteria. Where dimensions fall outside of prescribed limits, a separate list should be developed to contain these discrepancies.

A list should be compiled of all difficulties encountered with workspace as a result of physical characteristics of operating personnel. Next to each difficulty should appear the dimensions of the space involved and the dimensions of the affected body parts that relate to the specific space problem (extrapolations included). Clothing used during the testing should be described.

A summary of discrepancies should be listed with recommendations for each problem encountered.

5.7 TEST PROCEDURE - FORCE/TORQUE MEASUREMENT

5.7.1 Objective The purpose of this test procedure is to outline the criteria for force/torque measurement and describe methods for evaluating conformance to force/torque design criteria.

5.7.2 Criteria

5.7.2.1 Muscle Strength FIGURES 21 and 22 and TABLES XXIII and XXIV in MIL-STD-1472D show maximal forces in varying situations, grip forces, lifting criteria, and the minimal forces exertable in several attitudes for males. Lifting limits are subject to additional considerations described in paragraph 5.7.11.3 of MIL-STD-1472D. Additional muscle strength data for males and females are provided in section 2.4 of MIL-HDBK-759A(MI).

5.7.2.2 Resistance and Torque Limits Minimum and maximum limits for certain resistances and torques of various controls are found in FIGURES 4 through 20 and in TABLES IX, X, and XI in MIL-STD-1472D. These criteria are also included in the Force and Direction sections of the appropriate Sample Design Checklists in Appendix B of HEDGE.

5.7.3 Facilities and Instrumentation

5.7.3.1 Facilities None.

5.7.3.2 Instrumentation Instrumentation to be used is listed in TABLE 2-1. Instruments include force and torque dial gauges with attachments which permit these to be connected to controls and components, torque wrenches, measuring tapes and weight scales.

5.7.4 Method Force and torque limits should be based on the weakest potential operators and on work position, use conditions, clothing etc which may affect exertion of force and torque. Lifting and carrying performance should not be required at or near the limits of physical abilities as fatigue develops rapidly. Over and above the concern for discomfort and reduced effectiveness is the risk of injury which can occur in the form of muscle/ligament strain or rupture. Control resistance levels are subject to additional considerations. Resistance levels should be low enough to prevent fatigue and discomfort. However, they should be high enough to prevent inadvertent operation of the control and also provide kinesthetic cues to control movement.

5.7.4.1 General Guidelines Test participants representative of the male and female 5th and 95th percentiles in muscle strength should be selected. Identify the force application case in terms of body position, direction of force application and limb(s) used from the figures and tables referred to in paragraph 5.7.2.1 which most closely matches the force application required by the test item task. Use the force/torque measurment instruments listed in TABLE 2-1 to determine the maximum force in the applicable case of which test participants are capable. Select the test participant(s) which most closely approximate the male or female 5th and/or 95th percentile strength capabilities given in the criteria cited in paragraph 5.7.2.1.

Testing of activities that relate to data for certain resistances and torques of various controls referred to in paragraph 5.7.2.2 should be conducted utilizing the minimums and maximums as guidelines in evaluating equipment operation.

In areas of activity associated with force or torque for which there are no specific guidelines, test participants of the 5th percentile in strength should be observed for evidence of difficulty in carrying out assigned tasks.

There should also be concern if test participants representative of the 95th percentile report a lack of adequate friction in the movement of any of the controls required in the operation of the item.

Certain elements influence the strength of test participants over and above the inherent capacity of the individual. In the overall planning of a test, in the selection of test participants, and in approaches to specific requirements, the following factors (which tend to decrease strength) should be considered as applicable.

a. Age.

b. Altitude (lack of oxygen).

c. High ambient temperature, especially when combined with high humidity.

d. Acceleration.

5.7.4.2 Test Setup A review of tasks associated with the test item should be performed to compile a list of tasks requiring force or torque application including all hand and foot control operations required by the test item. A review of tasks should be performed to identify activities requiring force application, such as activating door or hatch handles. A review of required tasks should also be made to identify activities that require lifting or carrying weights.

5.7.4.3 Test Conduct The initial segment of the test will involve having each test participant activate each control, or a subset of representative controls, to each control setting. At the conclusion of these activities, the test participant will state that the force required to activate the control was too high, too low, or adequate. The HFE specialist will indicate on a checklist, similar to that shown in TABLE 5.7-1, those controls identified as having activation forces which are either too low or too high.

For controls identified by at least one test participant as requiring too little or too much force/torque, suitable measurements will be performed. The actual force/torque required to set the control to a specified setting will be measured five times and the average of the five measurements will be used as the force measurement for that control.

Average measurements for selected controls will be compared with the force/torque design criteria referenced in paragraph 5.7.2.2. Where force applications are required for controls or item components other than those identified in paragraph 5.7.2.2, the maximum values shall not exceed those presented for 5th percentile operators in the strength data referenced in paragraph 5.7.2.1.

The weights associated with each task from the compiled list of activities involving weight carrying or lifting should be compared with the data referenced in paragraph 5.7.2.1. These weight limits shall be used as the maximum values in determining the maximum weight of articles requiring one-soldier lifting, providing the article to be lifted conforms with the requirements of paragraph 5.9.11.3 of MIL-STD-1472D. Other lifting cases depending on the size and configuration of the lifted object and on the number of soldiers assigned to lifting it may result in modification of the tabled weight limits. Refer to paragraph 5.9.11.3 of MIL-STD-1472D to identify the appropriate weight limits subject to design features and task requirements for the test item.

Table 5.7-1. Sample Checklist for Control/Component Force Assessment

Control/ Component	Setting	Force/Torque			Comments
		Adequate	Too High	Too Low	
Door Latch	Open				
	Close				
	Lock				
Door	Swing Open				
	Swing Closed				
Emergency	On				
Brake	Off				
Headlights	On				
	Off				
Gear Select	Neutral				
	1st Gear				
	•				
	•				
	Nth Gear				
	Reverse				
Gear Range	High				
Select	Low				
Tractor	On				
Protection	Off				

5.7.5 **Data Required** Record the following data:

a. Anthropometric measurements of test participants (as applicable).

b. Item controls or components for which difficulty is noted in force application.

c. Force/torque measurements of controls and components which provided difficulty to test participants.

d. Weights of articles lifted or carried.

e. Strength measurements of test participants.

f. Comments by test participants of difficulties encountered.

5.7.6 Data Reduction and Presentation Force/torque measurements of those controls used in the operation of the item should be compared with force/torque limits prescribed for those controls as referenced in paragraph 5.7.2.2. Those controls whose force/torque measurements fall outside the limits should be listed separately.

Those tasks requiring force/torque application, weight lifting or carrying that produce activities outside of limits referenced in paragraph 5.7.2.1 should be listed separately. Any difficulties with force/torque application, weight lifting or carrying encountered by test participants that are not covered above shall be evaluated and, if determined to be valid, listed separately.

A summary of all discrepancies shall be compiled and recommendations made for each problem listed. TABLE 5.7-1 presents a Sample Checklist for Control/Component Force Assessment. TABLE 5.7-2 presents a Sample Data Summary Sheet for Control/ Component Force Assessment.

Table 5.7-2. Sample Data Summary Sheet for Control/ Component Force Assessment

Control/ Component	Identified Problem	Number of Participants Reporting Problems		Measured Force/Torque	Limit Value	Problem Verified
		5th	95th			

5.8 TEST PROCEDURE - HFE DESIGN CHECKLISTS

5.8.1 Objective Design Checklists are used by the HFE specialist in assessing the design features of the test item. Selection of specific checklists depends on the identification of Test Item Components. The determination of applicable Test Item Components is made using the relevant Test Item Class and Subclass as described in HEDGE.

5.8.2 Criteria The criteria for selection of Design Checklists are found in section 2.6 of HEDGE. Sample Design Checklists are provided in Appendix B of HEDGE. Where Sample Design Checklist items express required design criteria from MIL-STD-1472D, paragraph references are provided. Checklist items which do not have paragraph references are provided for guidance and were obtained from other HFE sources such as MIL-HDBK-759A(MI).

5.8.3 Facilities and Instrumentation

5.8.3.1 Facilities None.

5.8.3.2 Instrumentation Design checklists will be used by the HFE specialist in assessing design features while physically at the applicable workstation of the equipment undergoing test. Where problems are suspected in Test Item Component design, measurements will be made using applicable test procedures from sections 5.1 through 5.20.

5.8.4 Method

5.8.4.1 General Guidelines Whenever a design assessment is to be conducted, Design Checklists will be used. A Design Checklist form is presented in Appendix A of Part I and Sample Design Checklists are contained in Appendix B of HEDGE. The HFE specialist should identify the Test Item Class/Subclass and the applicble Test Functions as described in sections 2.1 and 2.2 of HEDGE. He/She should then identify the Test Item Components with which operators/maintainers interact in performing necessary tasks. These components are then evaluated in the HFE test. The HFE specialist should use the Design Checklists noted in FIGURE 3 of HEDGE for the Test Item Class/Subclass as guidance but should add or delete components and corresponding Design Checklists to or from the list based on the components associated with the test item.

5.8.4.2 Test Conduct The HFE specialist will use the appropriate sections of the Sample Design Checklists in Appendix B of HEDGE based on the review of components associated with the test item. Design Checklist items should be deleted which are not applicable or important for the item assessment. Where appropriate, Checklist statements which are not contained in the Checklist and which are judged to be important should be added. This can be done by photocopying Sample Design Checklists from Appendix B of HEDGE and modifying the copies.

The HFE specialist will determine if the Design Checklists will be used directly or if other personnel of the test agency will actually acquire the data using the checklists. If the former, then the HFE specialist only needs to copy relevant Design Checklists, acquire the instrumentation needed, and schedule time at the workstations of interest. If the Design Checklists are to be used by other personnel, the HFE specialist may need to adapt the checklist instruction for the users. The basic checklist instruction is as follows:

You are to assess design features of an equipment item using Design Checklists. You should use appropriate checklists for each operator workstation and the maintenance position at each item of equipment to be maintained. The statements in the checklists establish the criteria for the assessment. In some cases, compliance can be determined simply through observation. In other cases you will need to make measurements. Where measurements are required, you should sample components to be measured being sure to include any components which appear to have problems in terms of the criteria. If the component design meets the criterion described in a checklist statement, check it off as Adequate (YES). If it does not meet the criterion, check it as Inadequate (NO) and note the problem in the comments column.

5.8.5 Data Required Data are gathered by using the Design Checklists and any referenced design criterion documents such as MIL-STD-1472D at each workstation or maintenance position. Indications of whether Test Item Component design is adequate or inadequate on specific criteria are recorded. If the component is judged to be in compliance with the checklist item then the design is Adequate and the YES column is checked. If the component is not in compliance with the item then the design is Inadequate. The NO column is checked and the Comments column (and additional pages if necessary) is used to characterize the deficiency. The Not Applicable column (N/A) can be used if the Design Checklist statement is not applicable to the test item or item component.

5.8.6 Data Reduction and Presentation Design problems, noted as cases where components were judged Inadequate, will be listed. Judgments will be made as to whether these problems represent deficiencies or shortcomings. In determining that a problem is a deficiency or shortcoming the following checklist (from TOP 1-1-012) should be used:

a. Does the incident (performance or component):

(1) Create a hazard to personnel or equipment?

(2) Seriously impair operational capability?

(3) Cause serious damage if operations were to continue?

b. If the answer is YES to one or more of the above, is the incident:

(1) Something not anticipated in equipment of this type?

(2) A characteristic of design that requires change?

(3) Expected to occur again at similar frequency? (not random)

c. If the answer is "YES to <u>all three</u> questions in paragraph 5.8.6.b, then the problem is a true deficiency. If the answer to any one of the three is NO, then it is a shortcoming.

5.9 TEST PROCEDURE - PANEL COMMONALITY ANALYSIS

5.9.1 Objective This procedure describes a method for quantitatively establishing the commonality of controls and displays located on different consoles within the same system.

5.9.2 Criteria MIL-STD-1472D states that the arrangement of functionally similar or identical primary controls shall be consistent from panel to panel throughout the system, equipment, unit or vehicle (paragraph 5.4.1.3.4). The standard further states that where coding is selected for the purpose of differentiating among controls, application of the code shall be uniform throughout the system (paragraph 5.4.1.4.1). Concerning displays, MIL-STD-1472D states that the arrangement of displays shall be consistent in principle from application to application (paragraph 5.2.1.4.10).

5.9.3 Facilities and Instrumentation None.

5.9.4 Method Although MIL-STD-1472D states that controls and displays must be consistent from panel to panel in terms of location, arrangement and coding, the standard does not specify a minimum level of consistency or commonality. If the commonality between panels is not high, a greater number of operator errors can be expected through confusion and lost time looking for components on a panel after training on a different panel. For situations where an operator may be called on to operate either one of two panels at any time, the commonality between those panels should be at least 0.8, indicating that 80% of the controls and displays are similar along specified dimensions.

The dimensions of panels used for commonality assessment are as follows:

a. Presence: Controls and displays (C/D) are present on both panels where they are not unique to one of the panels.

b. Location: C/D are located in the same quadrants of the two panels.

c. Type: C/D are of the same type or shape on both panels.

d. Size: C/D are of the same size (±50%) on both panels.

e. Labeling: C/D are labeled identically in terms of function designation on both panels.

f. Arrangement: C/D are arranged similarly on both panels.

g. Color: C/D color is the same on both panels.

h. Operation: Direction of motion relationships between C/D is the same on both panels.

5.9.4.1 General Guidelines The HFE specialist will identify similar panels within the system which must be operated by the same test participants. The HFE specialist will then enumerate the controls and displays on each of the two panels (each pair of similar panels) using the Commonality Analysis Data Form from Appendix A of Part I. This listing will be made using panel drawings or using the actual panels. During the development of the list, notation will be made that a control or display is unique to a specific panel, and also if components which are not unique to a specific panel are present on both panels.

5.9.4.2 Test Conduct The HFE specialist will identify C/D commonalities using the Commonality Analysis Data Form from Appendix A of Part I. He/she will note if each control or display is not common along the specified characteristics using the following rules:

a. Location: Located in a different panel quadrant (upper right, lower right, lower left, upper left).

b. Type: C/D shape and type definitely different.

c. Size: The C/D on one panel is at least 50% larger or smaller than its counterpart on the other panel.

d. Labeling: C/D have different designations on different panels.

e. Arrangement: C/D are arranged in a way to cause confusion.

f. Color: C/D are colored differently.

g. Operation: C/D motion is definitely different due to factors other than shape/type.

5.9.5 Data Required The data to be collected in this procedure are the notations of C/D commonality along specified dimensions.

5.9.6 Data Reduction and Presentation When all data have been collected, the index of commonality for each pair of panels will be computed as follows:

$$L_C = P_P \times \left[\frac{3P_Q + 2P_T + P_S + P_I + P_A + P_C + P_O}{10} \right]$$

where:
- L_C = index of commonality.
- P_P = proportion of non-unique C/D functions present on both panels.
- P_Q = proportion of C/D present on both panels which are located in the same quadrant.
- P_T = proportion of C/D present on both panels which are the same type.
- P_S = proportion of C/D present on both panels which are the same size ±50%.
- P_I = proportion of C/D present on both panels which have the same identification label.
- P_A = proportion of C/D present on both panels which have the same arrangement.
- P_C = proportion of C/D present on both panels which are the same color.
- P_O = proportion of C/D present on both panels which have the same operation.

If the panel commonality index L_C is equal to or greater than 0.8 the panels are judged to have adequate commonality.

5.10 TEST PROCEDURE - HFE MAINTAINABILITY ASSESSMENT

5.10.1 Objective This test procedure describes methods to be implemented in assessing equipment or system design for maintainability from an HFE point of view. Methods are applicable to any stage of the system acquisition cycle and consequently to any system representation, from analytic concept through bread-boards, mockups, engineering prototypes, to production items.

5.10.2 Criteria Test criteria are provided in the applicable Sample Design Checklists in Appendix B of HEDGE. Sample Design Checklists are selected for use based on the Test Item Class and on the Test Item Components with which maintainers will interact during performance of necessary tasks. Where Design Checklist items express required design criteria from MIL-STD-1472D, paragraph references are provided. Checklist items which do not have paragraph references are provided for guidance and were obtained from other HFE sources such as MIL-HDBK-759A(MI). Some representation of the test item will be required which can be a: concept description, set of engineering drawings, bread-board, mockup, prototype, or production item. Additional criteria and methods for evaluation of maintainability are provided in TOPs 2-2-530 and 6-2-504.

5.10.3 Facilities and Instrumentation

5.10.3.1 Facilities For cold environment testing, shelters and enclosures will be required for maintenance in the field. These shelters will be required at least for aircraft maintenance in the cold environment.

5.10.3.2 Instrumentation Design Checklists will be used by the HFE specialist in assessing design features while physically located at the applicable maintenance location. Where problems are suspected in component design, measurements will be made using appropriate test procedures presented in sections 5.1 through 5.20.

5.10.4 Method In the operability assessment, the only sampling to be performed includes test participants and test condition sampling. The maintainability assessment also includes sampling of maintenance tasks and specific components to be assessed. Assessment time is probably limited to the extent that not every component of a system will be fully assessed. To the extent possible, the HFE specialist should use failure modes and effects analysis (FMEA) results to select maintenance tasks and components for testing.

5.10.4.1 General Guidelines The HFE specialist will use the Sample Task Checklists from Appendix A of HEDGE for the Maintainability Test Function and for the applicable Test Item Class to identify generic maintenance activities for the test item. Determination of Test Item Class is described in section 2.1 of HEDGE. Maintainability assessment will be carried out for items to which the Maintainability Test Function described in section 2.2.2 of HEDGE is applicable. Test Item Components which are generally involved in the Maintainability Test Function are indicated by Test Item Class in FIGURE 3 of HEDGE which should be used as guidance. The HFE specialist should also review the test item documentation and required maintenance tasks to identify any additional Test Item Components involved in maintenance activities. Test Item Components will then be added to or deleted from the list based on components associated with the item. Based on the review of Test Item Components, the appropriate Sample Design Checklists from Appendix B of HEDGE will be selected. The HFE specialist should delete statements from the Sample Design Checklists which are not appropriate for this item assessment, and should add statements which are not contained in the checklist and

which are judged to be important. This can be done by photocopying Sample Design Checklists from Appendix B of HEDGE and modifying the copies.

5.10.4.2 Test Planning The assessment will begin with an inspection of the test item and a review of item maintenance documents, manuals, guidelines, etc. The Sample Task Checklists provided in Appendix A of HEDGE can be used as guidance on generic tasks commonly required for items in the applicable Test Item Class. It will be necessary, however, to select and modify the generic tasks contained in the Sample Task Checklists to represent specific maintenance tasks actually performed on the test item. This can be done by photocopying Sample Task Checklists from Appendix A of HEDGE and modifying the copies.

Based on this review, a number of specific maintenance areas involving specific components, will be selected for the assessment. The selection of maintenance problems for cold environments should reflect an assessment of the effects of the cold environment on maintenance activities performed with the component (icing of test points and fasteners, effects of bulky clothing on maintenance workspace, freezing of lines and cables, handling of small parts with arctic mitts, etc.). Potential environmental effects on maintenance task performance are contained in Appendix D of Part I and in TOP 1-1-003. The selection should be, to the extent possible, based on failure mode and effects analysis data indicating the expected frequency and criticality of different types of failures for different components. For each selected failure situation, the environmental and operational conditions expected during the maintenance activity will be identified. Thus, if a work site for a specific maintenance operation is outside, weather (cold, dark, ice, snow, frozen terrain, and fog) will need to be considered in the assessment of environmental conditions. The HFE test methods to be considered for the maintainability assessment include:

a. Human Factors Analysis and Walk-Through - In both of these methods, the test plan will involve identification of failure conditions and associated maintenance activities, and will include the completion of the appropriate Design Checklists based on those in Appendix B of HEDGE.

b. Simulation and Human Performance Assessment - In these methods a technician will be given a problem and will perform the indicated maintenance task to resolve the problem. In the simulation method, conducted with a functional mockup or instrumented engineering prototype, some control is afforded in the selection of fault symptoms to evaluate the degree to which the equipment design enhances the troubleshooting operation. In the human performance method the technician will perform activities with a component assumed to have failed in some designated manner. His/her performance will be evaluated by an observer/recorder who will use Task Checklists such as those provided in Appendix A of HEDGE which have been suitably modified to reflect specific test item maintenance tasks.

c. Questionnaire/Interview - In these methods, maintenance personnel will be queried concerning their attitudes and opinions about the design for maintainability of the item to support specific maintenance activities. The questionnaire or interview can be developed from information contained in the Sample Design Checklists in Appendix B of HEDGE. Sample questionnaires/interviews are provided in Appendix B of Part I.

5.10.4.3 Test Setup

a. Human Factors Analysis/Walk-Through Setup for these methods is limited to setting up environmental conditions (e.g., lighting) for the walk-through.

b. Simulation/Human Performance Evaluation In these methods the setup must follow proper safety procedures for insuring the safety of the participating technicians.

c. Questionnaire/Interviews This method requires no special setup.

5.10.4.4 Test Conduct

a. Human Factors Analysis/Walk-Through The HFE specialist thoroughly reviews the drawings and documentation for the item design and will proceed step by step through the checklist with the item. As problems are identified measurements will be made to quantify the problems.

b. Simulation/Human Performance Evaluation In these methods the technician will perform designated maintenance tasks under the close observation of the observer/recorder. As problems are identified, the observer/recorder will note them on the checklist.

c. Questionnaire/Interview After obtaining experience maintaining the system, technicians will be asked to complete a questionnaire or to participate in an interview. These technicians may be the same test participants in the simulations or human performance assessments described above.

5.10.5 **Data Required** In the assessment of the item design for maintainability, the activities to be assessed and the appropriate work site for each, are listed below. Data required include completed Design Checklists, Task Checklists, Questionnaires and Interviews. Include also any photographs, video tapes, or films pertaining to the problem areas.

a. Work Site - Operating Console.

(1) Fault detection.

(2) Troubleshooting.

b. Work Site - Component Location.

(1) Component cleaning, tightening.

(2) Preparation of the system for component removal/replacement.

(3) Preparation of the component.

(4) Removal of the component.

(5) Handling/transfer of the component.

(6) Replacement of the component.

(7) Application of test probes to the component.

(8) Adjustment of the component.

(9) Test of the component in place.

(10) Component inspection.

c. Work Site - Maintenance Bench.

(1) Component assembly-disassembly.

(2) Component part fault isolation.

(3) Component repair.

(4) Component test and calibration.

5.10.6 Data Reduction and Presentation Design problems, noted as cases where components were judged inadequate, shall be listed. Judgments will be made as to whether these problems represent deficiencies or shortcomings. In determining whether a problem is a deficiency or shortcoming, the following checklist (from TOP 1-1-012) should be used:

a. Does the incident (performance or component):

(1) Create a hazard to personnel or equipment?

(2) Seriously impair operational capability?

(3) Cause serious damage if operations were to continue?

b. If the answer is YES to one or more of the above is the incident:

(1) Something not anticipated in equipment of this type?

(2) A characteristic of design that requires change?

(3) Expected to occur again at similar frequency? (not random)

c. If the answer is YES to <u>all</u> three questions in paragraph 5.10.6.b), then the problem is a true deficiency. If the answer to any one of the three is NO, then it is a shortcoming.

5.11 TEST PROCEDURE
INDIVIDUAL PERFORMANCE ASSESSMENT

5.11.1 Objective This section describes methods for testing individual performance in operating or maintaining equipment to support assessments of the HFE aspects of operational effectiveness and suitability of developing systems.

5.11.2 Criteria Performance criteria will include task/mission completion time, accuracy, resource consumption etc. If applicable, these will be established by the IAP, IEP, TDP, or Requirements Document.

5.11.3 Facilities and Instrumentation

5.11.3.1 Facilities Facilities, if any, will be those required to operate the test item.

5.11.3.2 Instrumentation - Still photography, video recording, timers and/or event counters may be required to document individual performance effectiveness. Equipment used for this purpose is listed in TABLE 2-1.

5.11.4 Method The orientation of performance testing is to provide data which bear directly on the issue of operational effectiveness, rather than the assessment of equipment design. The measurement concern is first directed toward obtaining global measures of performance at critical points in the mission. If these indicate deficiencies within an identified subsystem, then additional performance measures are examined to isolate procedural, coordination, or communication problems.

5.11.4.1 General Guidelines Production, pre-production or pilot models of equipment will be employed either in a simulated environment which will bear little resemblance to the intended operational environment or in the actual operational environment. In the Cold Regions environment, models of equipment will be employed under actual Cold Regions conditions. Recording equipment should be provided whenever relevant in order to obtain an objective, time-based record of subsystem output from which errors or omissions in control actuations can be identified. The records should also provide an indication of when specific out-of-tolerance conditions or malfunctions or other test scenario variables were inserted or occurred during the operation. In instances where recording equipment is unavailable or is not feasible, performance checklists, questionnaires, or interviews must be employed.

5.11.4.2 Test Strategy The purpose of the testing is to determine that the soldier/machine system or subsystem can perform within specified tolerances. The test scenario should sample a broad range of activities performed at the work station. Although the test participants may be MOS qualified operational personnel, they may be relatively unfamiliar with the system being tested. Therefore, pre-test practice should be sequenced so that activities generally progress from the easy to the more difficult during practice. If test participant performance is to be assessed under several test conditions or for competing items, then counter-balanced orders of presentation of test conditions or items should be used as described in section 3.11 of Part I.

5.11.4.3 Test Plan The HFE specialist will identify the operations and maintenance tasks to be performed and the equipment components used for each task. Each step in the sequence of tasks will be considered, noting potential problems of performance and safety. In the conduct of this type of analysis, the primary tool is the set of Sample Task Checklists provided in Appendix A of HEDGE. These generic tasks should be reviewed and

test item operating manuals, maintenance manuals, or other applicable documentation should be reviewed to identify specific tasks which are applicable to the test item. The HFE analysis should systematically consider each item contained on the Task Checklist. The analysis serves to familiarize the HFE specialist with the equipment and to identify potential problems which should be more fully investigated. The HFE specialist will have previously identified the environmental and operational conditions which could affect personnel performance or safety. When performing the HFE analysis, an attempt should be made to visualize the effects of the identified conditions, or preferably to perform relevant operational and maintenance tasks under selected environmental conditions to the extent possible. Examination of the completed checklist will serve to identify error likelihood situations. The conduct of an Error Likelihood analysis is presented in section 5.12.

5.11.4.4 Test Conduct In conducting a performance test, a number of representative test participants will carry out the sequence of tasks as defined in the checklist. The primary measure of interest is the adequacy of the task *output* when conducted under conditions representative of the range of conditions (temperature, daylight, snow, ice, and frozen terrain) expected in the environment. Customary measures are time, accuracy, and completeness, particularly when these variables are supportable by stated operational requirements or performance standards. Preferably, these measures are obtained from objective records of system output. When required system output standards are not achieved by the test participant, diagnostic measures are used to identify the nature of the difficulty. These diagnostic measures may be obtained from additional objective records of system performance (from which control activation times, errors, or omissions can be derived), or from direct observation of test participant performance, and from test participant interviews. The selection of the most appropriate method is contingent on the feasibility of obtaining objective recordings, and upon time and cost considerations.

Direct observation methods are economical and are practical to implement. However, they require the development of a Task Checklist and the presence of a trained observer to complete the checklist. Also, an observer is required at each subject station and each station may require a different checklist. In using this method, consideration must be given to the fact that the mere physical presence of the observer may serve to alter the test participant's performance. Moreover, there is a risk that inadvertent or erroneous actuations of controls may not be observed if the test subject's body blocks the observer's view of his actions. Similar difficulties may exist for television monitoring.

Video recording of individual performance can offer an alternative to direct observation. This approach is applicable where direct observation is not feasible because of space limitations, because the pace of events precludes detailed checklisting and commenting in real time, or because a number observers would be required to catch all performance events. Off-line analysis of video tape records can be used to obtain task or mission segment times and the tape can be rerun or frames can be stepped to identify performance problems. On the other hand, video has field-of-view and resolution limits and certain light levels may be required for useable video. These factors can sometimes offset the apparent advantages of the video approach. Further a video recording system can produce voluminous raw data. Processing to obtain performance times, critical incident descriptions, error reports, etc. can be labor intensive.

If checklists or performance records are used they should provide space for recording comments by the test participants and insights of the analysis. If the checklist is prepared as a performance record, space should be provided for recording such measures as time to respond, time to perform, and number of errors (of various types) observed during performance.

Questionnaires/interviews can also be applied to test participants to identify causes of inadequate performance. In the preparation of the questionnaire or interview guide the questions should be based upon the prior HFE analyses. The questionnaire items should specifically address each potential problem area which the analyses initially identified. The questionnaire responses will tend to confirm or reject the initial assessments and have the additional benefit of potentially providing practical operational solutions to identified difficulties.

As with other data collection methods, it is important to pre-test the questionnaire or interview guide. The pre-test is conducted to assure that the questions are meaningful and are understandable to the test participant and that they can be easily administered in the event that system output does not meet the established performance standards. The general features of the questionnaire which should be considered are described in section 5.18. See also TECOM PAM 602-1.

During large scale system or subsystem testing the activities of the performance assessment are predominantly concerned with monitoring. The test itself is monitored in order to record the occurrences of any deviations from the scenario which will influence analysis of HFE test results.

5.11.5 Data Required Data to be acquired includes the results of direct observation using Task Checklists, photographs, video recordings, objective task time measures, completed questionnaires, and interview results depending on the methods utilized in the test.

5.11.6 Data Reduction and Presentation If system, operator or maintainer performance outputs do not meet requirements, additional measurement results are reported which identify sources of problems. One useful adjunct in developing such a "diagnostic" portion of a test report is the Error Report provided in Appendix A of Part I. This kind of summary document can readily be prepared from data obtained from objective recordings, from checklists, or from interviews/questionnaires.

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5.12 TEST PROCEDURE - ERROR LIKELIHOOD ANALYSIS

5.12.1 Objective This procedure describes a technique for analyzing the adequacy of the design of controls and displays through estimates of the likelihood and criticality of errors when it is not possible to observe and collect actual error data. The technique should only be applied by a competent HFE specialist.

5.12.2 Criteria The criteria for scaling error likelihood are:

a. High Likelihood The control or display has major problems on at least one dimension; it violates HFE design criteria in such a way as to significantly increase the chance of operator error.

b. Moderate Likelihood The control or display has moderate problems on at least one dimension and no major problems along any dimension; it violates HFE design criteria of lesser importance, such as label stroke size.

c. Low Likelihood The control or display has no major or moderate problems on any dimension; it is designed in full accordance with HFE design criteria.

The determination of the above error likelihood factor depends on the degree to which the design of the control or display conforms to design criteria provided in sections 5.2, 5.3 and 5.4 of MIL-STD-1472D. Applicable sections of the Sample Design Checklists for Controls and Displays from Appendix B of HEDGE can be used in conjunction with the Error Likelihood procedure since these serve as a ready reference to MIL-STD-1472D design criteria.

5.12.3 Facilities and Instrumentation

5.12.3.1 Facilities None.

5.12.3.2 Instrumentation This analysis is to be conducted using an actual test item powered to the extent that lighting is on, controls are activated and displays are energized. Instrumentation from TABLE 2-1 to be used used includes a tape measure, force gauges, torque gauges, torque wrenches, push-pull gauges with attachments, and a protractor.

5.12.4 Method This technique will be used in the HFE test and analysis of complex systems only when there is insufficient opportunity to collect error data in a quantity to permit computation of error probabilities. The purpose of this alternate approach is to determine the relative likelihood of error occurrence based on the design characteristics of controls and displays. This likelihood is expressed in qualitative terms (high, moderate, and low) and the determination of the likelihood factor depends on the degree to which the design of the control or display conforms to design criteria provided in MIL-STD-1472D. Each control and display is to be analyzed in terms of the likelihood of error along specialized error dimensions.

5.12.4.1 Control Errors - The specific design features for controls, associated with each error dimension, which lead to decisions concerning the likelihood of specific errors are:

a. Inadvertent actuation error Actuation of a control accidentally (location of a control in the path of motion to another control, in a way that it is easily accidentally activated).

b. Substitution error Selection of the wrong control (two or more controls of the same size and shape placed next to each other, with too little separation and/or with improper identification labeling or poor lighting).

c. Sequence error Operation of controls in an order different from a required sequence (control location and arrangement not consistent with sequential operation or other causes associated with substitution error).

d. Activation error Selection of the wrong position or direction on the right control (a control designed in a way counter to convention, or which requires too much force to activate).

e. Temporal error Taking too much time to find or actuate the control (controls located where they are difficult to find and/or operate, or where insufficient illumination is provided).

5.12.4.2 Display Errors The specific design features for displays, associated with each error dimension, which lead to decisions concerning the likelihood of specific types of errors are:

a. Substitution error Reading the wrong display (two or more very similar displays placed close together with inadequate identification labeling).

b. Reading error Misreading the right display (poorly designed labels, marking, scales, alphanumerics, lighting).

c. Interpretation error Misinterpreting display information (information presented in a manner which is confusing, where the meaning is not readily apparent).

d. Temporal error Excessive time to find and/or read the display (displays located where they are difficult to find and/or to read or where lighting is inadequate).

5.12.4.3 General Guidelines A control or display which is judged to have a high likelihood of error occurrence on any one of the error dimensions is to be judged to have a high likelihood of error overall. Decisions concerning error criticality are made on a three-point scale as follows:

a. High criticality An error is to be judged of high criticality if it has a serious effect on operator safety or mission success or it has a moderate effect on operator safety or mission success and its occurrence is not readily detected by the operator or if its effect is irreversible.

b. Moderate criticality An error is to be judged of moderate criticality if it has a moderate effect on operator safety or mission success and its occurrence is readily detected and its effect is reversible.

c. Low criticality An error is to be judged of low criticality if it has no substantial effect on operator safety or mission success.

The HFE specialist activates the control, noting the amount of force/torque required. The number of positions, the presence of detents and stops, and control labeling are also noted as well as situations where a control is located close to another control which is similar in size and shape. The extent to which controls are functionally grouped is determined as is the degree to which shape coding, place coding, size coding, and color coding are used to differentiate controls. The use of guards on critical controls is also noted. Where problems are identified, the HFE specialist either makes a judgment directly concerning the error likelihood, or obtains measures to substantiate the assessment that a problem exists. Measures include reach distance, control separation, control size, pushbutton depression, toggle deflection, rotary activation angle, and control forces and torques.

Having made judgments concerning the likelihood of error for the specific control on each of the error dimensions, the HFE specialist notes if the occurrence of the error is immediately perceptible to the operator of the item and if the error is reversible. An assessment of the criticality of the error effect is then made using the definitions provided in paragraph 5.12.4.3.

The HFE specialist proceeds through the analysis of all controls in this way. Attention is then focused on console displays and the analysis of display location, visibility, labeling, readability, lighting, rate of response, parallax, character size, and number of similar displays. Display error likelihood and associated criticalities are noted.

5.12.4.4 <u>Test Conduct</u> Prior to the actual conduct of the analysis, the HFE specialist should obtain drawings of the control display panels to be analyzed from test item documentation, such as equipment manuals. (A review should be made of system specific controls or the reading of specific displays.) The controls should be listed on the Control Error Likelihood Worksheet included in Appendix A of Part I. Displays should be listed on the Display Error Likelihood Worksheet included in Appendix A of Part I.

The only setup needed for the conduct of this analysis is to activate the test item. The analysis should be accompanied by an experienced operator who serves as the primary source of the information concerning magnitude of the error effect.

The analysis is conducted with the test HFE specialist in the operator position at the console. Using the data forms included in Appendix A of Part I, each control and display is assessed. For controls, the HFE specialist reaches for the control and notes if this motion could cause accidental activation of another control. The HFE specialist also grasps the control noting if it is located too close to other controls.

5.12.5 Data Required Data obtained in this analysis includes the estimate of error likelihood and error effect criticality.

5.12.6 Data Reduction and Presentation Presentation will be made in tabular form. A sample presentation of control likelihood data obtained during an HFE analysis is provided in TABLE 5.12-1.

Figure 5.12-1. Presentation of Results of Control Error Likelihood Analysis

(Sample from Improved Hawk Air Defense System)

Control	Likelihood of Error	Error Cause	Effect Criticality	Effect
Off	High	Label doesn't denote function	Moderate	Deactivates ECCM modes
Freq. select	High	Poor labeling	Low	Change Range only Radar frequency
Release	High	One of two identical controls side by side	Low	Release Range only Radar circuits
Call	High	Same as above	High	Activates Range only Radar circuits
Range/Rate handwheel	High	One of three wheels located in a cluster - no label, no indication that depression of control expands range display Only .6 in. lbs needed to adjust	Low	Loss of time in getting range data to radar
Speed control	High	One of three wheels located in cluster - no label	High	Need to respond quickly in zero doppler
Elevation manual	Moderate	Labeling not clear	High	Cannot position radar
Elevation high	High	One of two identical pushbuttons located one on top of the other - confusing labeling	High	Radar not in high elevation search mode
Elevation low	High	Same as above	High	Radar not in low elevation search mode
Azimuth	High	One of three wheels located in a cluster - no labeling Difficult to access due to location of communication control panel	High	Fail to lock on to target

5.13 TEST PROCEDURE - CREW PERFORMANCE

5.13.1 Objective This procedure is concerned with HFE testing issues of specific relevance to assessment of crew performance. It should be considered as additional to the material presented in section 5.11 since many of the test preparation, planning, and data collection methods discussed for individual operator performance assessment are equally applicable to the assessment of crew performance. The present section is limited to those considerations which are unique to measurement of crew performance capability. Emphasis in the cold environment should be placed on the assessment of crew communications, the effects of arctic headwear and heater noise on voice communications, and the effects of reduced visibility conditions on communications via hand signals.

5.13.2 Criteria Criteria are established based on requirements of the IAP, IEP, TDP, or on required system performance. Criteria and methods for assessment of emplacement, action and march order capabilities of electronic/communication equipment are contained in TOP 6-3-505.

5.13.3 Facilities and Instrumentation

5.13.3.1 Facilities Facilities, if any, will be those required to operate the test item.

5.13.3.2 Instrumentation Still photography, video recording, timers and/or event counters may be required to document crew performance. Equipment used for this purpose is listed in TABLE 2-1.

5.13.4 Method The essential aspect which distinguishes crew performance from the aggregated output of a group of individual workers is the mutual cooperation or coordination which occurs in a well-trained crew accustomed to working together. The primary concern with crew performance testing is with communications and workloads.

5.13.4.1 General Guidelines Crew performance assessment will be conducted using the test item configured as it would be in an operational setting. The equipment should be functional, displaying simulated operational data and being responsive to control actuations. Scenarios or test protocols are required which should be representative of anticipated operational conditions and sequenced from "easy" to "difficult." Emphasis in the cold environment should be placed on the assessment of communications, the effects of arctic headwear and heater noise on voice communications, and the effects of reduced visibility conditions on hand signal communications.

5.13.4.2 Test Strategy A primary means of assessing crew performance is to examine individual workloads and, during peak load conditions, determine if the workload should be redistributed.

5.13.4.3 Test Plan Preparation of activities for assessment of crew performance are identical with those discussed in section 5.11 for individual performance testing. The checklists developed for such test purposes are examined for time-critical actions and typical use conditions. These portions of the checklist may then be extracted to serve as the basis for preparing observational records during system tests.

5.13.4.4 Test Conduct During those portions of the test scenario which involve the peak load conditions identified in the checklist, the observer will record the activities of the team members. Note that the attention is not directed toward assessing how well each member performs a task. The intent is to record the start and end times of each activity

performed by each team member. The record will indicate idle times for some team members when others are task-stressed. The observer may also be able to detect whether the idle team members are in a position to aid the overloaded workers. At this stage, observations are considered to be hypotheses concerning potential reallocations of duties.

These hypotheses are to be examined based upon questionnaire or interview data obtained from the crew members. Such questionnaires or interviews will probably not be amenable to development in the usual manner, including pre-testing. They will generally be developed during the testing as a result of observing such potential problem areas as:

a. Grossly unequal task distribution among team members.

b. Opportunities for one team member to assist another but failing to do so.

c. Instances where actions of a team member hinder the performance of another.

d. Omissions of tasks or task steps because they are not clearly assigned to a team member.

The questionnaire or interview items will generally cover the following types of topic areas:

a. Did your workload at any time become so heavy that, in your opinion, your performance suffered? If so, please explain. Try to be specific.

b. Were there periods of time that your workload was so light that you could have provided assistance to another member of the crew? If so, please explain. Try to indicate specific time periods.

c. Do you have any recommendations for redistributing the workload to achieve greater efficiency? If so, please explain.

d. Did the design of the equipment make it difficult to work with any member of the team? If yes, please explain.

e. Did all other operators provide proper assistance to you in carrying out your duties?

f. What modifications in the design of the equipment would improve the teamwork of the crew?

g. What modifications in the operating procedures would improve the teamwork of the crew?

h. Please provide any other comments or suggestions, either favorable or unfavorable, concerning the equipment design or operating procedures.

i. How adequate were communication methods? How were they affected by cold, clothing, ambient noise and the like?"

5.13.5 Data Required If objective system and subsystem performance requirements have been established, the performance analysis will monitor subsystem outputs to assure that they meet the established standards. If they do not, causal factors should be identified.

5.13.6 **Data Reduction and Presentation** Recommendations developed in this test procedure will have implications for equipment design, crew station layout, or personnel training. Data will be summarized from questionnaires and interviews and presented in tabular form.

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5.14 TEST PROCEDURE - INFORMATION SYSTEMS

5.14.1 Objective This section describes measurement considerations in assessing information system functioning. The timely flow of information coordinates the activities of operators/maintainers and the degree of usefulness of the transmitted information can set limits on the performance of the full system. Material in this section is relevant to any information flow network even though it has been prepared within the context of a command-control center where converging data paths provide factual data for use by decision makers.

5.14.2 Criteria Information processing systems can be analyzed in terms of their performance in accomplishing four basic information processing functions: disseminating information, compiling information, computing, and providing ready access to a data base. For particular systems, differential weights may be assigned to each of these, in accord with their approximate relative importance in the system, in order to derive an overall measure of system performance. Criteria for evaluation of the soldier-computer interface are contained in TOP 1-1-059. Criteria for control and display aspects of information systems are contained in appropriate sections of the Controls and Displays Sample Design Checklists in Appendix B of HEDGE.

5.14.2.1 System Performance In assessing system performance, the unit of measurement is the individual message. Performance criteria, if available, should be stated in terms of system responsiveness (time), thoroughness (proportion of messages reaching the specified user, or proportion of responses satisfying queries), and readability of messages (legibility and understandability).

5.14.2.2 Information Quality In assessing the quality of information processed by the system the unit of measurement is the data item or the data field (in a fixed format message). Information quality criteria are relevance, timeliness, completeness, and accuracy.

5.14.3 Facilities and Instrumentation

5.14.3.1 Facilities Tests of information systems are generally conducted incrementally during early stages of system development. Full-scale testing is seldom possible until the time when a production unit of the system is available. The reason is that command/control systems are generally developed and delivered incrementally. Initial deliveries may, for example, be limited to a central processor and its associated executive and general software. Subsequent deliveries may add peripheral equipment capabilities and functional software capabilities. Each increment has associated testing considerations. In all instances testing is accomplished with the actual equipment. The facilities will vary, depending upon the type of test being conducted.

5.14.3.2 Instrumentation None.

5.14.4 Method A system which expedites the transport of messages results in a more efficient communication of the contained information. This capability is a characteristic of the system's performance and is logically separable from the characteristics of the information contained with the message.

However, efficient message flow has little merit if the quality of information in the messages is degraded to the point of being incomprehensible. Consequently, a second facet of information processing system efficiency is the preservation of required information quality.

5.14.4.1 General Guidelines The distinction between measures of system performance and measures of information quality is crucial. In brief, assessment of information processing system efficiency requires both the measurement of the processing of messages and measurement of the information the messages contain. There are certain information processing functions which information systems perform. These functions are the measurement areas of interest.

An advantage of this functional orientation lies in its generalizability. There are a limited number of information processing functions which can be performed by a system and these functions continue to apply regardless of changes in the other variables. The functions are: dissemination, data retrieval, compilation, and computation.

a. Dissemination refers to the capability of transporting information from a data source to one or more physically separated participants. An automated system provides dissemination capability by direct routing (message switching or relaying or automatically by comparing data with subscriber lists of standing requests for information (SRI).

b. Data Retrieval refers to the accessing of a data file as a consequence of a request to select and report specific information.

c. Compilation refers to the function of extracting only specified information items from files. It necessarily involves "retrieval," but is a higher order effort since it implies multiple retrievals and an ordering or sequencing (transposing) of related information items in the output message. Performance of this function involves the search, identification, extraction, and sequencing of items from lists of items in accordance with clearly specified logic rules.

d. Computation refers to arithmetic manipulation.

Considerations are identified below for analyzing message processing performance and information quality in terms of the above four information processing functions.

5.14.4.2 System Performance The message is the carrier of information. Therefore, certain performance dimensions can be defined which are directly relevant to the efficiency with which a system permits a message to transport information. The message must be transported rapidly from its source to its destination, and it must present the information which it contains in a usable form. These performance dimensions are termed responsiveness and readability.

5.14.4.2.1 Responsiveness in Performing System Functions The most important characteristic of an information system is the rapid provision of information to a participant. This rapid provision of information may be viewed as rapidity in relaying information from a source to a participant (dissemination) or it may be viewed as rapidity in responding to requests for certain kinds of information (query/response).

a. Dissemination Within an automated system, desired information can be automatically routed to a particular participant. A measure of primary importance is that of the elapsed time from the moment information is made available to a system until the message(s) containing that information is made available to a participant.

A procedure should be defined which permits the timing of a message from the moment information is provided for entry into the system until it is made available to the responsible participant(s). In accomplishing this it is of little importance whether the full report of the event is transmitted as a single message or as several. The HFE specialist needs to know the exact text, and time and location of insertion of the original report of the event. The HFE specialist must also identify the units of information in the original message which will be of interest to each participant served by the system, and must time the receipt of each unit of information at its destination.

System responsiveness is, then, considered to be the elapsed time from provision of the report of an event to receipt of a relevant message by each concerned participant.

b. Query/Response Problem situations often arise which require information which may not be locally displayed. In such situations a request may be made for the desired information.

A query message may be inserted to search the computerized data base. System responsiveness in performing this search may be defined as the elapsed time from a participant's expression of the query to the moment a usable response is received back. (Once again, the quality of the information in the response will be discussed separately, below.)

c. Compilation and Computation These functions are special cases of the query described above. The measure of system responsiveness can be defined as the elapsed time from start to completion of the function. "Start" is defined as the time that a participant or the machine begins to organize or manipulate the data to produce an output message. Completion of the function is defined as the time the message containing the desired information is made available.

Regardless of the function being analyzed, it is obvious that the actual quantitative value of throughput time or response time depends upon the required processing and (in the case of multiprocessor or multiprogramming capabilities) is also dependent upon other jobs being processed. In all but the very simplest systems there is an established priority imposed upon the various terminals or type of systems demands. These priorities are in turn determined from operation considerations. Thus, the ultimate demands of the system analysis require these performance statistics (throughput time and response time) to be gathered for each class of demand on the system.

5.14.4.2.2 Information Quality When a message is received by a decision maker there are four characteristics of its contents that are of immediate concern.

a. Relevance The measure of relevance as a dimension of information quality is concerned with the provision of only necessary and sufficient data to any selected participant. If an information system fails to provide necessary information, the quality of problem solutions must, by definition, suffer. On the other hand, if the system provides much irrelevant information, the participant may be unable to cope with the bulk of data and the quality of problem solutions may also be degraded.

For an automated system the issue of determining what information is relevant can often be resolved by each system participant who may file control messages in the system to indicate the types of information he/she

wants to receive. Within limits imposed by the system's ability to "recognize" types of data, the participant may specify as much or as little information as he/she desires. Thus, a measure of "relevance" will have a restricted applicability for sophisticated systems which automatically disseminate information. All data messages received at a particular station should be relevant in terms of each participant's definition, unless the participant fails to enter all of his/her criteria.

b. Timeliness. A primary requirement of an information system is that it provides information as soon as possible after an event of interest has occurred.

c. Completeness. Completeness can be defined as the percentage of data items present in a message as a function of those available and relevant to user needs. Its measurement requires considerable subjective judgment and its general use for all messages cannot be recommended. For specified message types, however, it may be useful.

d. Accuracy. In determining which data items are in error, the criteria in most instances will be the contents of the message which was provided for input to the system. Thus, if an enemy unit location is input, the geographic coordinates must be unchanged as the message is processed through the system. This standard can be applied directly for all data messages, most query messages, and most messages which result in compilations of data.

5.14.4.3 Test Strategy. The primary objective of Design Testing is to assure the satisfactory functioning of portions of the system operating singly and in unison. These include the system operators and maintainers, hardware, software, communications, and operating procedures. Each of these has the potential of disrupting or introducing distortion in the information flowing through the system. Consequently, each must be addressed prior to the conduct of assessments of full system performance. Because hardware and software are usually delivered incrementally, test repetitions must occur; test objectives and content will increase in scope with each such repetition.

5.14.4.4 Test Plan. Tests plans will specify the following as a minimum:

a. Purpose of test.

b. Implications, or requirements for the test.

c. Test environment.

d. Specific equipment requirements and configurations.

e. Participating military units.

f. Test personnel and their duties.

g. Requirements for military personnel and logistical support.

h. Test materials including specific test messages.

i. Test procedures (detailed).

j. Criterion measures.

k. Scoring and data reduction procedures.

l. Data analyses.

m. Test schedule.

Test messages which will serve to initiate predictable system responses will be prepared in advance and these messages will be traced from source to expected destination. In this manner, all system capabilities will be exercised, from simple message routing responses, to queries, to complicated functions. The tests will sample across a range of tactical contingencies and will exercise all system capabilities (including automatic dissemination, data repository, and collation and computational capabilities). Diagnostic scoring procedures will be employed so that data flow inadequacies may be traceable to the following kinds of error: user data input error, communications, software inadequacy, hardware inadequacy or malfunction, or procedural errors.

The design verification test will be sufficiently comprehensive to assure that all major portions of the system are fully checked-out and integrated and meet design specifications. The tests will attempt to duplicate tactical operating conditions and to assure efficient performance of each data processing function under operational conditions. During certain of the tests, "failures" will be introduced on a controlled basis to assure that the system operates as intended under simulated conditions of system degradation.

5.14.4.5 Test Conduct Specific control procedures will be defined and data collection procedures will be outlined in detail. In general, the following will be performed for each of the tests:

a. Ascertain that the system operators, maintenance personnel, military observers, and contractor personnel required for the tests are available on site.

b. Brief regularly assigned and interim test personnel on any unusual test requirements.

c. Verify that the hardware configuration is as specified.

d. Load pretest data.

e. Manually maintain a test journal throughout the test for post-test analysis.

f. Recover selected message printouts.

g. Provide for analysis the test journal, message printouts, and a log tape, to include:

    (1) Operational messages.

    (2) Control messages.

    (3) Record of detected equipment malfunctions.

A distinction is drawn between an exercise scenario (which controls the nature and frequency of events scheduled to occur during the full system test) and the HFE test scenario (which is the listing of the sample of stimulus messages within the context of detailed test operating procedures).

The HFE specialist should work closely with the senior test engineers and exercise controllers to attempt to insert into the exercise scenario test messages of particular importance to the attainment of HFE test objectives. The test scenario in this instance

will be the exercise scenario with relevant incidents and messages, with tagged scenario material.

The determination of what will constitute a relevant incident and message will be based upon the following analytic scheme:

a. Assure that major information content areas and significant machine processes are presented in the test in terms of specified message types.

b. Determine specific output message content, required input message content, and relevant data files and machine processes for each selected message type.

c. Identify source(s) and potential uses of each message type.

d. At each data transfer point, indicate criteria relevant to assessment of system functioning and provide suggestions for their measurement during exercise observations.

5.14.5 Data Required A comprehensive running account of each test will be manually maintained throughout the periods of test. This detailed journal will serve to record every incident relevant to system operation, including: equipment and software performance; operator, participant, and observer remarks; changes in equipment configuration; time and conditions for initiation or close-out of test phases: and any departure from the planned test operating procedures. The journal will become a part of the test report.

5.14.6 Data Reduction and Presentation The general testing scheme will be to structure scenarios to present realistic problem situations which will be reflected in preselected types of output messages. The output messages should be assessed in terms of their quality. Since controlled input data were introduced, a standard exists against which output message quality can be assessed. In the event of information degradation, attention can be directed to diagnostic scores to determine the source of the error, as was discussed earlier in this section. Data should be presented in tabular form and compared to applicable criteria.

5.15 TEST PROCEDURE - TRAINING ASSESSMENT

5.15.1 Objective The purpose of this test procedure is to provide HFE specialists with descriptions of methods, criteria, and measures for the assessment of the adequacy of new equipment training (NET). The procedure applies to: (1) the assessment of training as part of a broader HFE test and assessment of a specific system, and (2) the assessment of training programs and systems in their own right. In either case the procedure is applicable at any one of three periods: prior to the actual conduct of training, when the system is still under development; during the conduct of training; and after completion of training, when the system is being deployed.

5.15.2 Criteria The assessment of training effectiveness entails measuring trainee performance along defined dimensions in terms of required levels of performance as stated in the IAP, IEP, TDP, or test item requirements documentation. Manuals used in training can be evaluated using procedures contained in TOP 1-2-609. Additional criteria and methods for training evaluation are contained in TOPs 7-3-501 and 10-2-501.

5.15.3 Facilities and Instrumentation None.

5.15.4 Method An assessment of training requires a test and analysis of the adequacy of training methods and media, and an assessment of the effectiveness of the training. The test and analysis techniques appropriate for the assessment of training methods and media include:

a. HFE analysis.

b. Observation/checklist of training activities.

c. Interviews.

d. Questionnaires.

e. Training effectiveness assessment.

The only one of these assessment techniques which is applicable to a test and analysis of training prior to the actual conduct of the training is the HFE analysis. This analysis involves: inspecting training equipment; reviewing documentation on training procedures; and identifying training measures and relevant criteria. Based on these inspections and surveys, problems are identified in the areas of:

a. Course content.

b. Training material and media.

c. Training procedures.

d. Training measures and criteria.

e. Instructor capabilities.

5.15.4.1 General Guidelines Observations, interviews, and questionnaires will be constructed to identify problems in these same areas. However, these techniques may only be applied during and after the actual conduct of the training. Measurements of training effectiveness can only be conducted after training is completed.

5.15.4.2 Test Strategy Test method alternatives include the following:

a. HFE Analysis In this method the HFE specialist will prepare a checklist addressing the assessment of training equipment and materials prior to the actual administration of training.

b. Observation Here the HFE specialist will prepare a checklist to be used in recording the assessment of observed, on-going training.

c. Questionnaire/Interview In this method the trainees will provide information concerning their assessment of the training course and of their own capability levels.

d. Performance Measurement In this assessment of training effectiveness data will be obtained which reflects the level of performance of trainees after training. The data will be compared against performance requirements or criteria identified for the system.

5.15.4.2.1 HFE Analysis The checklist to be developed and used by the HFE specialist in the assessment of the training program prior to the conduct of training must address the following areas:

a. Course content:

(1) Complete and comprehensive, conveys all that the trainee needs to know.

(2) Compatible with the general entrance skill levels of trainees.

(3) Organized in a building block approach.

b. Training materials and media:

(1) Test materials are clear and readable.

(2) Sufficient training aids and instructional materials are provided.

(3) Manuals are organized by subject matter.

c. Training procedures:

(1) Feedback provided to the trainee concerning his/her performance and status.

(2) Time spent in training is sufficient.

(3) Training of procedures is parallel with item use.

d. Training measures and criteria:

(1) Specific measures of training effectiveness are available.

(2) Criteria are available which are unambiguous.

e. Instructor capabilities:

(1) Instructor skills and knowledge (as instructors as well as subject matter experts) are specified.

(2) Instructor selection criteria are indicated.

5.15.4.2.2 Observation The observation of selected test participants as trainees proceeding through the course or instructional period will also require use of a special checklist to record problem areas. The checklist will provide space next to each time critical task for citing problems in terms of the assessment aspects discussed above under HFE analysis.

5.15.4.2.3 Questionnaire/Interview Questionnaires and interviews will sample trainee opinions and attitudes toward training received. The HFE specialist will first list the important subject matter areas and will then format the data (questionnaire or interview guide) to address for each subject matter area:

a. The trainee's skill level at the termination of training.

b. Whether sufficient training time was expended in the area.

c. Whether materials and documents were readily readable.

d. Whether instructors were effective.

The questionnaires to be used include the NET (New Equipment Training) Analysis Questionnaire and the Training Debriefing Questionnaire provided in Appendix A of Part I.

5.15.4.2.4 Performance Measurement The HFE specialist will list all tasks included in a training course, and will identify measures of trainee performance for each. He/she will also determine if performance criteria or standards exist for each individual task, either in general or specifically for the system or training course. Finally, the HFE specialist will determine how to acquire data on each of the identified measures (observation, sensors, instrumentation, timers, data obtained from other item subtests, etc.).

5.15.4.3 Test Conduct Training assessment will be conducted as described in the respective test plans.

5.15.5 Data Required The data required includes the results of the HFE analysis, observations, questionnaires, interviews, or performance measurements.

5.15.6 Data Reduction and Presentation For all methods other than performance measurement, the significant results of the assessment are the problems identified for training. In the performance measurement method, comparisons will be made between acquired levels of performance and performance criteria. Data will be presented in tabular form.

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5.16 TEST PROCEDURE - WORKLOAD ASSESSMENT

5.16.1 Objective This procedure is concerned with assessment of the magnitude of task loading placed on individual operators during different operational conditions and with identification of workload problems which may lead to reduced operator/maintainer performance.

5.16.2 Criteria Workload criteria can address either physical workload in terms of force exertion and lifting requirements or mental workload in terms of information load, information processing, decision rate, etc. Physical workload is addressed in section 5.7. Mental or cognitive workload is of relevance in HFE testing in that excessive workload imposed by item tasks may exceed human capabilities and lead to errors which impact personnel safety and/or mission success.

5.16.2.1 Assessment of Workload Problems A Workload Assessment Form is included in Appendix A of Part I. This is actually a specialized interview form which the HFE specialist uses to elicit descriptions of workload problems from experienced operators/maintainers.

5.16.2.2 Workload Measurement A number of workload measurement methods have been developed and used to provide numerical criteria for magnitude of workload. These methods generally involve analysis of system/item task requirements and ratings of task information load, cognitive demand, difficulty, complexity, etc. by experienced operators/maintainers. While workoad measurement methods provide systematic approaches for quantifying workload based on judgments and reports by experienced personnel, there are questions of validity and interpretation attached to outputs of these. Existing workload measurement methods may be applicable to certain Test Item Classes such as Air Vehicles and to certain test objectives such as comparative analysis of competing systems. HFE specialists working in test areas where task workload is relevant to test item evaluation should review the workload measurement area based on their particular test requirements. The current status of workload measurement has been reviewed in considerable detail by Lysaght et. al. (1989). References are provided in Appendix F. Methods, measures and criteria which may have applicability to HFE testing include:

a. Analytic Techniques
   - (1) Workload components (Aldrich, Craddock & McCracken, 1984)
   - (2) Subjective Workload Assessment Tool (SWAT) (Reid, Shingledecker and Eggemeier, 1981)
   - (3) Pro SWAT (Eggleston & Quinn, 1984)

b. Subjective Techniques
   - (1) Modified Cooper-Harper scale (Cooper & Harper, 1969)
   - (2) WCI/TE scale (Donnell, 1979)
   - (3) NASA Task Load Index (TLX) (Hart and Staveland, 1987)

5.16.2.2.1 Analytic Techniques The analytic and subjective measures listed above all involve some type of subjective judgment on the part of experienced system operators. The analytic technique category has been split out here to include workload techniques which can potentially be applied during system development before mockups, simulators, or actual prototypes are available for operation. The subjective techniques, on the other hand, use rating scale responses by operators during or following item operation.

The McCracken-Aldrich workload components approach (Aldrich, Craddock & McCracken, 1984) utilizes task analysis and an approximate time line or sequence of tasks applied during system development phases. Tasks are characterized as requiring, in varying degrees, operator cognitive resources on dimensions of cognitive, visual, auditory, kinesthetic, and psychomotor. Tasks are described as conceptual designs are developed. Candidate tasks are assigneo values on each of the five resource dimensions by experienced operators who also provide estimates of task durations. In developing a workload measure, the ratings are summed across concurrent tasks and produce total demand on each of the five dimensions at each point in time. The McCracken-Aldrich methodology has been applied to a number of helicopter mission phases.

The Subjective Workload Assessment Tool (SWAT) (Reid, Shingledecker and Eggemeier, 1981) has potential for both analytical workload estimation during development and for workload rating during task performance. Three workload dimensions are addressed by SWAT. These are time load, mental effort load and psychological stress load. On each dimension, three levels of difficulty are defined. Before rating tasks, subjects perform a card sort in which cards containing all 27 possible combinations of levels on the three dimensions are rank ordered according to judged workload. Essentially, this establishes a relationship between levels on the three load dimensions and total workload for each subject. Following the card sort, SWAT raw data can be collected in two ways. If system tasks can be performed in a simulator or existing system, then operators can be asked to judge the level of load on the three dimensions after the task in question has been performed. A second use of SWAT does not require the existence of a system or system simulator. If tasks can be described which will be performed in a future system, then operators of a similar predecessor system review the task descriptions and provide SWAT dimension ratings. This approach has been called Projective SWAT (Pro-SWAT)by Eggleston and Quinn (1984).

5.16.2.2.2 Subjective Techniques Workload measures in the subjective techniques category above were were developed for and have generally been applied to cases in which an operator performs system tasks using the system under test. The Modified Cooper-Harper Scale (Cooper & Harper, 1969) is a unidimensional workload rating scale with 10 intervals. Raters are provided with materials describing each scale value and are asked to assign a scale value to a given task. The NASA Task Load Index (TLX) uses six workload dimensions - mental demand, physical demand, temporal demand, performance, effort, and frustration (Hart and Staveland, 1987). The first three dimensions are considered to assess external demands placed on the operator while the last three assess internal characteristics of the task. A weighting technique is provided to combine task ratings on the six dimensions into a single workload metric. This is based on judgments by raters of the importance of each dimension for overall workload.

5.16.3 Facilities and Instrumentation None.

5.16.4 Method Distribution of workload within a crew affects operator performance. With the formation of any group which is to function as a crew (in the operation of equipment) there is concern that the workload of each participant is not distributed in a manner that will permit maximum efficiency. Optimum distribution of workloads is a goal that attempts to achieve maximum efficiency and effectiveness of operation.

5.16.4.1 General Guidelines Underloaded positions should be combined with other underloaded positions with the same skill or with similar tasks. Additional manpower should be added to overloaded positions or the work stations should be redistributed.

To determine periods of peak personnel and equipment overload, the HFE specialist may use a form of time line analysis which plots operator activity against time. In this way he/she can observe excessive task demands as well as excessive inaction. To confirm or to supplement observations, questionnaires may be given to the test participants to provide for their inputs.

Questions may be asked, such as:

a. Did your workload at any time become so heavy that, in your opinion, your performance suffered? If so, please explain. Try to be specific.

b. Do you believe there were periods of time that your workload was so light that you could have provided assistance to another member of the crew? If so, please explain. Try to indicate specific time periods.

c. Do you have any recommendations for redistributing the workload to achieve greater efficiency? If so, please explain.

5.16.4.2 Test Conduct The HFE specialist will identify critical tasks using the appropriate Sample Task Checklists provided in Appendix A of HEDGE as a source of generic tasks for the Test Item Class and Subclass. Test item documentation including operating manuals, maintenance manuals and inputs from experienced operators of the test item will be used to identify critical tasks which are specific to the test item. These critical tasks will then be enumerated on the Workload Assessment Form contained in Appendix A of Part I or used as the task set to which workload measurement techniques are applied. Prior to listing the tasks the HFE specialist will identify the tactical and/or environmental conditions, selecting the conditions which should produce maximum and minimum workload for the operator

Working with test participants who are experienced operators/maintainers of the test item, the HFE specialist will obtain the data needed to assess workload or identify workload problems. These data will include time requirements for each critical task such as time constraints (limits on time available) or time to perform (measured or estimated). Identification will then be made of the tasks conducted simultaneously by the operator. Effects of time delays on completion of the critical tasks will be evaluated and, based on these data, workload problems will or will not be identified. Ratings of the workload dimensions of critical tasks will be obtained if workload measurement methods are being used as described in paragraph 5.16.2.2

When the test item is clothing or personal equipment to be worn in the field, an assessment must be made of the effect of wearing the article of clothing and/or equipment on the operator's workload. A test of fatigue effects of clothing or equipment is presented in Section 5.19, Dexterity.

5.16.5 Data Required If the Workload Assessment test utilizes the Workload Assessment Form from Appendix A of Part I then the data will consist of completed forms which identify workload problems. If workload measurement methods are used as discussed in paragraph 5.16.2.2, then these will result in workload rating data which should be reported along with test test conditions, critical tasks, workload definition assumptions, and summary workload metrics

5.16.6 Data Reduction and Presentation A summary tabulation of critical tasks having workload problems or workload measurements by task or mission segment will be constructed. Where competing systems or system variants are being compared in

terms of workload, tabulation of workload by system will be prepared to facilitate comparison.

5.17 TEST PROCEDURE - TASK CHECKLISTS

5.17.1 Objective The purpose of this procedure is to identify operator or maintainer performance problems through the use of Task Checklists.

5.17.2 Criteria None.

5.17.3 Facilities and Instrumentation

5.17.3.1 Facilities None.

5.17.3.2 Instrumentation Photographs and/or video tape recording using equipment listed in TABLE 2-1 may be useful in documenting results of task checklist testing.

5.17.4 Method The HFE specialist will review the Sample Task Checklists provided in Appendix A of HEDGE for the Class and Subclass in which the item has been categorized as described in section 2.4 of HEDGE. Sample Task Checklists contain generic types of tasks which are often applicable to the Test Item Class and Subclass. Test item documentation including operating manuals and maintenance manuals will be reviewed to identify specific tasks required by the test item. The HFE specialist will strike tasks from the list, add other tasks not on the list, or change the sequence of tasks as appropriate. This can be done by photocopying the Task Checklists from the HEDGE document and modifying the copies.

5.17.4.1 General Guidelines The major step in the planning of tests using the Task Checklists is to complete the checklists as described in paragraph 5.17.4 above. In preparing for the test, the HFE specialist should identify potential performance problems based on his/her experience with similar items. He/she should also identify performance criteria specified in the IAP, IEP, TDP, or Requirements Documents for each task. If appropriate, cold regions environmental effects to be considered in the assessment of each task, and of task sequences, will be identified using Appendix D of Part I.

5.17.4.2 Test Conduct A pretest will be conducted by having an HFE specialist walk through the sequence of tasks to identify potential problems, as part of the HFE analysis. This process is described in section 3.5 of Part I. The actual performance testing using the task checklists entails having test participants, selected to be representative of at least the extremes of the population, walk through the sequence of tasks. Where the participant notes problems he/she advises the HFE specialist who is observing and completing the checklist. At other times the HFE specialist may identify a problem, or may interrupt the sequence to question the participant concerning a potential problem. In this manner the entire task checklist is completed. In completing task checklists, check the YES column if performance on the task is adequate and no problems are encountered. Check the NO column if performance on the task is inadequate and problems are encountered. Use the Comments column (and additional sheets if necessary) to describe any task performance problems identified. Check the N/A column if the checklist item is not applicable to the test item.

5.17.5 Data Required Descriptions of the existence of performance problems, with information covering the likely cause of the problem, are to be noted.

5.17.6 **Data Reduction and Presentation** Data reflecting problems identified in the use of this procedure will be categorized as deficiencies or shortcomings using the criteria identified for Design Checklists in section 5.8. Data from the Comments column of the Task Checklists will be presented in tabular form. Video recording of selected task walk-throughs may be useful to document task performance problems. Photographs of the item components or design features involved in task performance problems may be useful to document task problems and related design deficiencies.

5.18 TEST PROCEDURE - QUESTIONNAIRES AND INTERVIEWS

5.18.1 Objective While the HFE specialist should attempt to collect objective data whenever possible, there are many test situations where it is not possible, or where objective data are not sufficient to enable a complete analysis of a system or test item. In these situations, the HFE specialist should make full use of subjective methods in assessing the HFE aspects of an item or system.

Subjective methods differ from objective techniques primarily in the source of obtained data. In the subjective approach, the data used in the assessment are opinions and comments provided by experienced operators of the the test item or system. In the objective methods, the data are derived from measurements of item or system design features or characteristics.

In this sense, subjective methods serve several different purposes which are important for the HFE test objectives. First, they provide the means to analyze the HFE aspects of an item where no objective measures are available. Second, they serve to supplement and support objective data by providing additional information on problems and causal factors in problems. Third, they enable assessment of personal aspects of an item (acceptability to the participant, participant comfort, convenience of item design). Fourth, they provide a method to sample the degree to which the item participants know what they need to know. Thus, the types of information to be obtained by subjective methods include attitudes, opinions, and preferences of participants, insights into problems, judgments of the adequacy of design features or procedures, and indications of their knowledge.

5.18.2 Criteria None.

5.18.3 Facilities and Instrumentation

5.18.3.1 Facilities It is usually the responsibility of the HFE specialist to make arrangements for a suitable room in which to hold a group interview or administer questionnaires. In this case, consideration must be given to selecting a centralized location convenient to most of the group (to minimize transportation requirements) and to the availability of seating and writing facilities. Consideration must also be given to environmental factors such as adequate heating or cooling, lighting, and a lack of distracting noises or activities which would adversely affect the results. In addition to ensuring an adequate supply of questionnaire forms and pencils, the administrator also should make arrangements for visual displays which may be required for the orientation; these may include actual samples of the test items to be assessed during the interview or photographs of the items in various configurations. Such displays are often helpful to the respondents in identifying the items discussed in the questionnaire.

5.18.3.2 Instrumentation Photographs may be useful to document design features of test items or problems referred to by questionnaire/interview respondents. Applicable equipment is listed in TABLE 2-1.

5.18.4 Method

5.18.4.1 Questionnaires A questionnaire involves a series of structured questions presented to a group of test participants in order to sample their ~~opinions,~~ attitudes, and preferences concerning an item, components of the item, or procedures involved in using the item. Questionnaires usually require a participant to rate the component or operation in some dimension ranging from extremely positive to extremely negative.

Based on these responses, the HFE specialist has information concerning what participants think of the item. The primary advantages of the questionnaire are: (1) its orientation to the item operation, operator, or maintainer; (2) the fact that it can be administered to a group of participants simultaneously; and (3) its capacity to sample opinions and attitudes while placing a minimum workload on the participant. Usually all the participant needs to do is check off the best answer, much as in a multiple choice test. The main disadvantage of the questionnaire method is that it is limited to sampling opinions on these aspects of the item which the developer of the questionnaire has identified beforehand as potential problems and for which the participant has knowledge. The participant may have insights into problem areas which have escaped the questionnaire developer, and the questionnaire form usually does not enable the participant to identify such areas. A second drawback of questionnaires is that they usually require a respondent to note that a problem does or does not exist, and if it does, the magnitude of the problem. Such a form does not provide additional information on the perceived causes of the problem. This disadvantage is usually avoided through the inclusion of an open-ended question which provides space for the participants to expand on their answers to specific questions.

Questionnaires are usually administered at the conclusion of the test or test segment when there are more than 10 test participants. While checklists are concerned with the problems observed during conduct of individual tasks, questionnaires attempt to identify problems based on participant opinions, attitudes, and insights. Questionnaires either directly ask if the participant has [illegible]nced problems, or they have the participant rate an operation or equipment component along some dimension (performance, design, safety, comfort). Rating scales are usually constructed to include from four to six responses. One approach is to include an even number of alternatives (usually four or six), half of which are positive and half negative. An advantage to rating scales which have an even number of responses is that the participant is forced to select either the favorable side or the negative side of the scale. There is no central or neutral or no opinion response available so the participant cannot choose to "sit on the fence". Sample equal appearing interval rating scales are provided in Appendix B of Part I

A good deal of care must be exercised in the development of questionnaire items. First and foremost, since the completion of a questionnaire requires time and effort on the part of the respondent, the length of the questionnaire should be as short as possible while covering the required objectives. Second, the HFE specialist should select questions where the answers will be valuable in the assessment of the item rather than using the questionnaire for background or clarifying information. Third, the phrasing of questions and available responses must be such that it does not bias the response one way or the other. Finally, each individual question should be as clear and concise as possible. The only way in which a participant can interpret what it is that the HFE specialist wants to know is from the wording of the question. Lengthy or obtuse questions will require the participant to infer the meaning and intent of the item, with a good probability that the inference will be wrong.

5.18.4.2 Interviews An interview is a subjective technique which provides a maximum of information from representative participants, especially in terms of insights and acceptability estimates. Interviews should be used when there are 10 or fewer participants. A drawback to the interview technique is the time it requires to administer. Unlike the questionnaire, the interview can only be administered on an individual basis. Therefore, to sample the opinions and attitudes of a number of participants, the time required to collect this information varies as a direct function of the number of interviewers and interviewees. A second common failing of the use of the interview technique is the treatment of the interview as an unstructured, open-ended

discussion period. The most effective approach to interviewing proceeds from the use of a structured interview guide. This guide represents a set of questions which are asked of each participant. Use of this guide ensures that topics discussed by different participants are comparable, and also that the problem areas identified by the HFE specialist are discussed. The guide will identify the questions to be posed to participants. Responses can be recorded in written form in space provided on the guide or, when practicable, on a voice tape recording which can be transcribed at a later time.

The structured interview guide is made up of a series of questions selected on the basis of their relative importance for the assessment of the item. The same series of questions is presented to each participant. The relevance of the series to real problems with the item depends in large part on the care taken by the developer of the guide in identifying questions which are directed toward acquiring additional information on the real problems. The use of the interview technique avoids one problem involved with the use of questionnaires, that of depending totally on the ability of the HFE specialist to identify the problem areas where additional information is required.

5.18.4.3 Questionnaire Preparation Sample questionnaire items are shown in Appendix B of Part I. Construction of a questionnaire should proceed through the following steps, using TECOM PAM 602-1, Volume I as a guide:

a. Preliminary Planning Identify information required from test participants, questionnaire administration procedures, sample size and type, location of administration, data analysis techniques.

b. Selection of Questions Select responses as dichotomous (yes-no), forced choice (positive and negative only - no neutral middle level), multiple choice (series of alternative responses), rating scale (scaled series of responses from highly positive to highly negative), and/or open-ended (provision for participants to add comments, explanatory information, etc.).

c. Wording of Questions Wording of questions is to be concise, understandable, clear, unbiased, and relevant. Where questions are required which address item comfort, protection, ruggedness, fit, or overall acceptability, this can be done by selecting statements from those in TABLES 5.18-1, 5.18-2, 5.18-3, 5.18-4, or 5.18-5. The statements in these tables are used in place of the 6 point rating scale in Appendix B of Part I in which 1 is the least favorable, and 6 the most favorable rating. The tables show a mean rating and standard deviation of ratings for each statement. The means and standard deviations in the above tables arose from ratings of favorability/unfavorability of statements by raters. Note that these persons were not rating a test item - they were rating statements. The mean rating expresses where a question falls on the 6 point scale. For item comfort in Table 5.18-1, for example, the statement "Superior comfort" has a mean rating of 5.50 and indicates a very favorable response. If a test participant chose "Superior comfort" as applicable to a test item, then the score of the item on the dimension of comfort would be 5.50. On the other hand, if a test participant selected the statement "So uncomfortable it can barely be worn" as applicable to the test item, then the item would only score 0.40 on comfort. The standard deviations reflect the spread of rating responses to statements. A large standard deviation indicates greater variability in the rating responses to a particular statement. This means that raters were not able to respond consistently or unambiguously to a statement. The larger the standard deviation, the greater was the rater uncertainty about how to rate the

statement. In Table 5.18-1, the statement "Extremely comfortable" is more ambiguous than is "Excellent comfort" since the standard deviation for the former is larger than that for the latter. To use the above tables, select five or six statements which span the range from 0 to 6. Where there is a choice between statements having similar mean ratings, select the statement having the lower standard deviation. See paragraph 5.18.6 for an example the use of the above tables.

d. Formulate Questionnaire Formulate sequencing of questions, assurance of adequate coverage, and wording of instructions. Questionnaires need to contain items addressing the following:

(1) Overall ease of operating the test item

(2) Overall ease of maintaining the test item

(3) Overall user acceptability of the test item.

e. Pre-test Questionnaire Use a small representative group of participants to identify problems in meaning of responses, intent of questions, length of questionnaire, etc.

5.18.4.4 Interview Preparation The construction of interviews entails the development of a structured interview guide. The guide is actually a questionnaire used for obtaining data from a relatively small group (10 or fewer test participants). Requirements for the guide are the same as those identified above for questionnaires. A sample interview guide is presented in Appendix B of Part I.

5.18.4.5 Test Conduct Conducting the test requires completion of questionnaires by test participants and/or conduct of the interviews with test participants using the interview guide. Instructions to participants should stress that their honest opinion is being sought about the test item and that the data will be used for evaluation of the test item - not for grading the participants. The questionnaire or interview is not a test with correct and incorrect answers. There should be no threat/reward aspects to participation due to rank, nature of responses, etc. and, perhaps more importantly, none should be perceived by participants. Often, this requirement can be met by assuring participants of anonymity. This can be accomplished by not asking for the participant's name. Anonymity may not be practical because the participant may be involved in other aspects of the test, or it may be desirable to contact participants later for additional data. It may suffice to assure participants that their names will be retained only during the test, that each individual's responses will be averaged or combined with those of others, and that no permanent record of responses will be kept from which individual participants can be identified. In general, the best means available should be employed to assure participants that they will not suffer from having given their honest responses which they believe best characterize the test item.

Table 5.18-1. Mean and Standard Deviation of Ratings of Statements for Use in Developing Specific Rating Scales for Item Comfort

Mean	Standard Deviation	Item Comfort Statement
5.50	0.84	Superior comfort
5.44	0.75	Superior in comfort
5.42	0.69	Excellent comfort
5.04	1.01	Exceptionally comfortable
4.99	1.45	Extremely comfortable
4.93	0.93	Perfectly comfortable
4.43	0.99	Very comfortable
4.41	0.65	Comfort is very satisfactory
4.13	1.38	Unusually comfortable
3.72	0.78	Comfort is satisfactory
3.51	0.87	Generally quite comfortable
3.44	0.59	About average comfort
3.39	0.83	Fairly comfortable
3.24	0.80	Moderately comfortable
2.58	0.81	Not too uncomfortable
2.57*	0.86	Usually comfortable but sometimes uncomfortable
2.40	0.70	Slightly uncomfortable
2.32	1.00	Uncomfortable at times
2.30	1.00	Comfort is not quite adequate
2.05	1.09	Comfort is not very satisfactory
1.84	1.05	Comfort is barely adequate
1.75	0.78	Below average in comfort
1.68	0.91	Somewhat uncomfortable most of the time
1.66	0.86	Slightly uncomfortable all the time
1.47	1.42	Quite uncomfortable
1.40	1.14	Very uncomfortable at times
1.12	2.02	Extremely uncomfortable
1.00**	0.85	Much below average
0.81	0.78	So uncomfortable it can only be worn for a short time
0.49	0.87	Very uncomfortable
0.40	0.78	So uncomfortable it can barely be worn
0.26	0.94	So uncomfortable it can't be worn

Table 5.18-2. Mean and Standard Deviation of Ratings of Statements for Use in Developing Specific Rating Scales for Item Protection

Mean	Standard Deviation	Item Protection Statement
5.65	0.78	Protection is perfect in every respect
5.55	0.54	Excellent protection
5.47	0.92	Protection is superior
5.05	0.77	Protects extremely well
4.94	1.03	Protection is ideal
4.49	0.70	Protection is very satisfactory
4.26	1.02	Protects unusually well
4.12	0.77	Protection is above average
3.99	0.74	Protection is good
3.98	1.00	Protection is very good in most respects
3.50	0.87	Protection is satisfactory
3.31	0.92	Protection is adequate
3.26	0.82	Protection is moderately good
3.23	0.85	Protection is about average
3.20	0.94	Protects about as well as most equipment of its type
3.10	0.89	Protection could better in some ways
2.90	0.76	Protection is fair but could stand improvement
2.60	0.83	Protection is fair
2.58	1.11	Protection could be improved
2.41	0.99	Protection needs improving
2.37	1.17	Protection is not adequate under extreme conditions
1.94	0.93	Protection is not quite adequate
1.83	0.94	Protection is barely adequate under moderate conditions
1.81	1.06	Protection is barely adequate
1.78	0.92	Protection is not very satisfactory
1.78	0.71	Protection is below average
1.44	1.23	Protection is hardly noticeable
1.13	0.98	Protection is slightly better than nothing at all
0.92	0.83	Protection is much below average
0.87	0.80	Protection is poor
0.66	1.42	Protection is completely inadequate
0.21	0.70	Protection is so poor item serves no purpose

Table 5.18-3. Mean and Standard Deviation of Ratings of Statements for Use in Developing Specific Rating Scales for Item Ruggedness

Mean	Standard Deviation	Item Ruggedness Statement
5.24	0.74	Superior for rough usage
5.09	0.70	Extremely rugged and well made
4.96	0.09	Exceptionally rugged
4.90	0.81	Excellent for rough usage
4.65	0.73	Very rugged
4.48	1.00	Durability is ideal
4.33	1.15	Unusually rugged
4.32	0.88	Durability is very satisfactory
4.14	0.92	Above average in ruggedness and durability
3.93	0.68	Very rugged in most respects
3.85	0.82	Quite rugged
3.71	0.85	Adequate durability for rough usage
3.59	0.81	Durability is quite satisfactory
3.25	0.98	As rugged as most equipment of this type
3.24	0.95	Quite rugged but needs some improvement
3.23	0.73	Durability is satisfactory
3.08	0.77	Moderately rugged
2.98	0.82	Durability could be improved
2.94	0.62	Average durability
2.66	1.05	Not quite rugged enough
2.37	0.97	Durability is not quite adequate
1.92	1.20	Shows excessive wear after moderate usage
1.80	0.78	Not very rugged
1.56	1.01	Won't stand up under rough usage
1.53	0.84	Below average durability
1.46	0.88	Durability is not very satisfactory
1.42	1.08	Durability is barely adequate
1.40	1.35	Easily damaged, shows excessive wear
1.21	1.07	Flimsy material and/or construction
1.15	1.12	Won't stand up under normal usage
0.63	0.77	Very poor durability
0.55	0.67	Poorly made, low durability

Table 5.18-4. Mean and Standard Deviation of Ratings of Statements for Use in Developing Specific Rating Scales for Item Fit

Mean	Standard Deviation	Item Fit Statement
5.81	0.71	Fits perfectly in every respect
5.66	0.79	Fit is excellent
5.61	0.88	Fit is superior
5.49	0.92	Fits extremely well
5.18	1.08	Fit is ideal
4.89	0.79	Fit is very good
4.71	1.17	Fits unusually well
4.41	0.99	Fit is quite satisfactory
4.29	0.79	Fit is very good in most respects
4.25	0.83	Fits comfortably
4.00	0.83	Fit is above average
3.73	0.81	Fit is about average
3.71	0.90	Fit is satisfactory
3.44	0.93	Fit could be improved
3.40	0.86	Fit is adequate
3.27	0.77	Fit could be better in some ways
3.25	0.74	Fit is moderately good
3.07	0.62	Fit is fair
2.98	0.97	Fit needs improving
2.87	1.00	Fit needs some adjustment
2.35	0.86	Fit is not quite adequate
2.00	0.74	Fit is poor but item is wearable
1.94	0.74	Fit is below average
1.79	1.01	Fit is barely adequate
1.69	0.78	Fit is not very satisfactory
1.25	1.23	Fit is poor
1.19	0.91	Fit is much below average
1.11	0.94	Fit is so poor item can only be worn for short periods
0.96	0.90	Fit is is so poor item can only be used under limited conditions
0.80	1.07	Fit is very poor
0.76	1.10	Fit is so poor item can't be worn comfortably
0.30	0.86	Fit is so poor item is unusable

Table 5.18-5. Mean and Standard Deviation of Ratings of Statements for Use in Developing Overall Acceptability and General Rating Scales

Mean	Standard Deviation	Item Overall Acceptability Statement
6.27	0.54	Excellent
6.22	0.86	Perfect in every respect
5.74	0.81	Extremely good
5.19	0.75	Very good
5.03	0.98	Unusually good
4.62	0.72	Very good in most respects
4.56	0.75	Above average
4.35	0.95	Quite satisfactory
4.25	0.90	Good
4.13	1.11	More than adequate
3.77	0.85	About average
3.69	0.87	Satisfactory
3.58	0.77	Moderately good
3.39	0.87	Adequate
3.28	1.09	Could use some minor changes
3.10	1.30	Not good enough for extreme conditions
2.72	1.15	Not good for rough use
2.11	0.76	Not very satisfactory
2.10	0.84	Barely adequate
2.10	0.85	Not very good
2.03	0.79	Below average
2.00	0.87	Unsatisfactory but usable
1.97	1.12	Needs major changes
1.83	0.98	Barely acceptable
1.79	0.90	Not adequate
1.76	1.21	Not good enough for general use
1.22	1.08	Better than nothing
1.06	1.11	Poor
0.76	0.95	Very poor
0.69	1.32	Very unsatisfactory
0.36	0.76	Extremely poor

5.18.5 Data Required Data required from questionnaires and interviews include participant characteristics as well as responses.

5.18.6 Data Reduction and Presentation Consideration must be given to the quantification and analysis of data during the early stages of questionnaire and interview development. Plans for the design and administration of the questionnaire/interview, as well as for data quantification and analysis, must be developed in conjunction with the overall plan of the test. This is essential in order to determine such factors as:

a. The kind of sample required.

b. The number of participants to be included in the sample.

c. The frequency and schedule of administration.

d. The number and type of questions to be used.

e. The type of analysis which will be performed.

It is unlikely that the questionnaire/interview designer will also be a qualified statistician or knowledgeable of statistical analysis techniques. Therefore, it is essential that the individual responsible for the design of the questionnaire or interview seek the assistance and advice of a qualified statistician. In order to ensure that the questionnaire produces the desired data, it is suggested that the planning task be approached by first deciding what hypotheses will be tested. By this process it is possible to determine what analysis techniques can be employed to test the hypotheses and something about the tabulations which will be required to summarize the results. From these tabulations, it is possible to determine the types of questions needed and some characteristics of the sample required to produce the results. Again, it is emphasized that early consideration must be given to the form which the data will take and the kind of analysis which will be made of the data when they are obtained. If this step is ignored, a great deal of time and effort may be wasted in testing the initial hypotheses.

The end product of the questionnaire or interview procedure may be a simple frequency distribution of responses to each question summarized in terms of numbers, proportions, or percentages. The data may be further summarized to include averages and standard deviations. These quantified data must then be tabulated and analyzed. The results are summarized in tabular form for inclusion in the final report as shown in TABLES 5.18-6 and 5.18-7.

TABLE 5.18-6 presents the results of questionnaire items taken from TABLES 5.18-1, 5.18-4, and 5.18-5 to assess two sets of body armor - a standard and an experimental version. Tests of the items were conducted over a two-week period and test participants were asked to fill out questionnaires for both test items after one and after two weeks of use. Characteristic 1 in TABLE 5.18-6 is freedom of movement. Questionnaire response statements were taken from TABLE 5.18-5 for overall acceptability of the body armor sets in terms of freedom of movement. The first response is "Extremely good" whose mean rating scale value in TABLE 5.18-5 is 5.74. The numerical score values shown in TABLE 5.18-6 are the mean ratings from the appropriate statement tables rounded to the nearest integer. Therefore, the statement "Extremely good" was taken to represent a rating of 6. Similarly, the second statement about freedom of movement is "Very good in most respects". The mean rating of this item from TABLE 5.18-5 is 4.62 and this was taken to represent a rating score for the item of 5. The remaining statements in TABLE 5.18-6 were selected similarly. TABLE 5.18-1 was used for comfort ratings; TABLE 5.18-4 was used for item fit; and TABLE 5.18-5 was used for maneuverable efficiency. The response frequencies in TABLE 5.18-6 are the numbers of test participants who selected each statement as most applicable to the two test items during the first and

second weeks of testing. It can be seen that the experimental item was generally preferred to the standard item on all four criteria throughout testing. Presentation of the average ratings in TABLE 5.18-6 facilitates the comparison. For example, the average rating for the standard body armor during the first week calculated for the 22 participants was (2 x 5 + 19 x 4 + 1 x 3)/22 = 4.045 or approximately 4.0

Table 5.18-6. Sample Summary of Rating Response Frequencies on Four Characteristics of Body Armor

				Response	Frequency		
				1st Week		2nd Week	
App	Characteristic	Numerical Rating	Score	Std	Exp	Std	Exp
D	1. Freedom of Movement	Extremely good	(6)	0	1	0	1
		Very good in most respects	(5)	2	13	1	17
		More than adequate	(4)	19	7	17	3
		Adequate	(3)	1	1	4	1
		Below average	(2)	0	0	0	0
		Very poor	(1)	0	0	0	0
		Average rating		4.0	4.6	3.9	4.8
	2. Comfort	Superior comfort	(6)	0	2	0	2
		Extremely comfortable	(5)	7	14	5	16
		Comfort is satisfactory	(4)	12	5	15	2
		Not too uncomfortable	(3)	1	0	1	2
		Below average in comfort	(2)	1	0	1	0
		Extremely uncomfortable	(1)	1	1	0	0
		Average rating		4.0	4.7	4.1	4.8
	3. Fit	Fit is excellent	(6)	2	5	3	7
		Fit is very good	(5)	15	17	17	13
		Fit is above average	(4)	5	0	2	2
		Fit needs improving	(3)	0	0	0	0
		Fit is below average	(2)	0	0	0	0
		Fit is very poor	(1)	0	0	0	0
		Average rating		4.9	5.2	5.0	5.2
	4. Maneuverable Efficiency	Extremely good	(6)	0	2	0	2
		Very good in most respects	(5)	4	11	4	16
		More than adequate	(4)	15	8	16	4
		Adequate	(3)	3	1	2	0
		Below average	(2)	0	0	0	0
		Very poor	(1)	0	0	0	0
		Average rating		4.0	4.6	4.1	4.9

At 5% level of significance experimental vest rated better than standard vest on all characteristics for both weeks.

Table 5.18-7. Sample Summary of Response Frequencies from Daily Interviews on Body Armor

Question	Response	1st Wearing Std. (22)	1st Wearing Exp. (22)	2nd Wearing Std. (22)	2nd Wearing Exp. (19)	3rd Wearing Std. (22)	3rd Wearing Exp. (22)
1. Have you been able to satisfactorily perform all your duties?	Yes	20	17	18	17	19	22
	No	2	5	4	2	3	0
2. Were your body movements restricted in any way by the vest?	Yes	9	5	3	1	1	2
	No	13	17	19	18	21	20
3. Do you feel that the fit of this vest is adequate?	Yes	21	22	22	19	22	22
	No	1	0	0	0	0	0
4. Have you found that this vest interferes with the clothing or equipment you are wearing?	Yes	1	1	1	0	0	0
	No	21	21	21	19	22	22

Data obtained from rating scales, dichotomous responses, and pre-coded answers are not difficult to quantify since numerical values or pre-coded numbers are assigned ahead of time. The written responses to open-end or "Why?" type questions require the additional steps of coding and classification prior to tabulation and analysis.

After the data have been quantified, they must be organized into a form which will aid in the analysis and presentation in the report. The construction of a table is an effective means of organizing the data obtained from a questionnaire. A table serves several purposes. It may be used to list the raw data in terms of frequencies of response or percentages of response to each question; the response frequencies may be further organized by test group, test phase, date of administration, etc. For example, TABLE 5.18-7 shows response frequencies for YES and NO answers to questions about usability of standard and experimental body armor. The columns are used to separate response frequencies by test item (standard versus experimental) and by trial number or wearing of the test items. In TABLE 5.18-8, the data from the first question in TABLE 5.18-7 have been converted to percentages. The numbers in the column headings of TABLES 5.18-7 and 5.18-8 give the number of test participants who completed the daily interview after each wearing. Therefore, the percent of participants who gave a particular answer is the frequency from TABLE 5.18-7 divided by the number of participants in the column and multiplied by 100. For example, following the first wearing of the standard armor, 20 participants of 22 responded YES to the first question in TABLE 5.18-7. The corresponding percent in TABLE 5.18-8 is (20/22) x 100 = 90.9 percent. Conversion to percentages is especially desirable when the response frequencies arise from varying numbers of participants. In TABLE 5.18-8, during the second wearing, it was not possible for all 22 test participants to use the experimental

body armor. Since this sample of interview data arose from only 19 participants, the response frequencies in this column of TABLE 5.18-7 cannot be directly compared with those in other columns. This comparison can be made more readily using the percentage data in TABLE 5.18-8. Notice that it is not very informative to table both YES and NO response percentages for dichotomous questions since the two percent figures must add to 100.0. The calculation, however, provides a good check on accuracy.

Table 5.18-8. Sample Summary of Response Percent from Daily Interviews on Body Armor

		Response Percent					
		1st Wearing		2nd Wearing		3rd Wearing	
Question	Response	Std. (22)	Exp. (22)	Std. (22)	Exp. (19)	Std. (22)	Exp. (22)
1. Have you been able to satisfactorily perform all your duties?	Yes	90.9	77.3	81.8	89.5	86.4	100.0
	No	9.1	22.7	18.2	10.5	13.6	0.0

A table may sometimes be lengthy; however, the importance of the results may justify including a raw data table as an appendix to the report. A table also may serve to summarize the findings by the presentation of an organized and concise picture of the findings which support the conclusions and recommendations.

In the organization of a table, careful consideration must be given to the most important information contained in the table and the main points it is intended to bring out. The table must then be designed so that the main points are the easiest to observe. In this regard, it must be remembered that people read from left to right across the page and, therefore, headings of columns must be more prominent and easier to follow than headings of rows. If the information contained in the columns and the rows is of equal importance, consideration should be given to the fact that long lists of data look better in columns and short lists in rows. In some instances, results may be effectively summarized and presented in a graph or chart. There are many types of graphic techniques, including the bar graph, pictograph, pie diagram, and trend chart, which may be used instead of a summary table or to summarize the principal findings from several tables. As an example, the response percent data from TABLE 5.18-8 have been plotted in the form of a bar graph in FIGURE 5.18-1. The bar graph data suggest that participant ratings of the experimental test item improved as a function of experience with it. This was not true for the standard item which received approximately constant ratings allowing for statistical variation. Note too that if the percentages were averaged over wearings, the scores for the the two test items would be quite similar. The trend for the experimental body armor to out-perform the standard item later in test trials is clarified by the graphic presentation. This apparent trend should be subjected to an appropriate test of statistical significance, however, before reporting in favor of the experimental item.

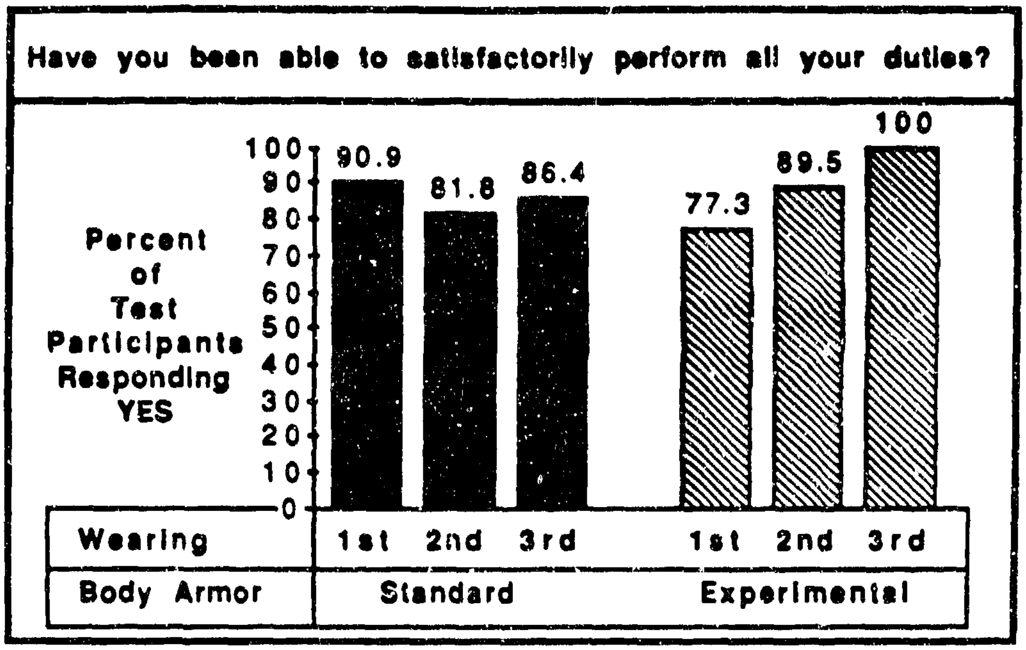

Figure 5.18-1. Sample Bar Graph of Response Percent from Daily Interviews on Body Armor

Analysis of data must include a careful examination of the data to provide answers to questions such as:

a. Are specific item requirements met or not met?

b. What are the causes and effects of not meeting requirements?

c. Are there differences between standard and experimental items?

d. Are the differences obtained meaningful?

e. How do the findings relate to the conclusions and recommendations?

f. Are there unexpected findings or new facts which warrant further investigation?

5.19 TEST PROCEDURE - DEXTERITY

5.19.1 Objective The objective of this procedure is to provide a method of quantitatively assessing finger dexterity as affected by different types of handwear, cold, or fatigue. The procedure addresses three different issues: (1) the effect of experimental handwear on dexterity, as compared with standard handware, (2) the effect of the temperature within an enclosure on manual dexterity, and (3) the degree of fatigue, measured by the decrement in dexterity, produced by exertion while wearing experimental clothing and equipment.

5.19.2 Criteria

a. Handwear Assessment Dexterity scores obtained from participants wearing experimental handware shall not be significantly lower than scores obtained for standard handwear.

b. Temperature Assessment Dexterity scores obtained after working bare-handed for two hours within an enclosure shall not differ significantly from scores obtained from the same participants in a warm enclosure.

c. Clothing/Equipment Assessment Decrements in hand dexterity obtained after completing the CRTC Handwear Testing Course, as compared to scores obtained before completing the course, while wearing experimental clothing or equipment shall not be significantly greater than decrements obtained wearing standard clothing or equipment.

5.19.3 Facilities and Instrumentation

5.19.3.1 Facilities For the clothing/equipment assessment, the CRTC Handwear Testing Course should be used. No facilities are required for the other two tests.

5.19.3.2 Instrumentation The test recommended for the measurement of dexterity is the O'Connor Finger Dexterity Test. This test consists of a plate in which there are 100 holes 3/16 inch in diameter arranged in rows 1/2 inch apart. Into each of these holes the test subject inserts three steel pins one inch long and 1/16 inch in diameter. The test score is computed as follows: the number of seconds required to fill the second half of the board is multiplied by 1.1, and the time in seconds required to complete the first half is added to this figure. The test score is equal to one-half of the sum. For example, if a subject filled the first half of the board in 252 seconds, and the second half in 238 seconds, his/her score is 238 x 1.1 = 261.8 + 252 = 513.8 x .5 = 257.

Other dexterity tests which may be used include the Minnesota Manual Dexterity Test and the Grooved Pegboard Test . If more than one dexterity test is available, use only one throughout the testing of a given item or during a test project. Scores from the different tests are not directly comparable.

5.19.4 Method

5.19.4.1 General Guidelines

a. Handwear Assessment This test is more concerned with manual dexterity itself as affected by different types of handwear than with temperature effects. Therefore, the test need not be conducted in the cold as long as the test participant's hands do not become too warm, to the point of discomfort.

b. Temperature Assessment In this test the concern is with effects of temperature on barehanded dexterity within an enclosure such as a vehicle cab. The test participants should be required to perform normal activities with the system or item (driving, equipment checkout, surveillance, communications, etc.) for a period of two hours with their hands uncovered for that time. Enclosure heaters should be operational and running. At the beginning and end of the two-hour period, dexterity measurements are made.

c. Clothing/Equipment Assessment The change in dexterity scores obtained before and after an activity can serve as an indication of the workload, and resultant fatigue, associated with the activity. In the assessment of experimental cold weather clothing and equipment, the effects of these items on wearer workload should be established.

5.19.4.2 Test Setup

a. Handwear Assessment A group of test participants of the same sex should be selected with one third of the group having hand dimensions (length and width) in the 5th to 35th percentile range, one third in the 35th to 65th percentile range, and one third in the 65th to 95th percentile range. The group will be split into as many equal size subgroups as there are handwear configurations to be evaluated. No group should have fewer than 15 participants (5 for each hand size category). Handwear sized as "small" should be distributed to personnel in the appropriate handwear configuration subgroup having hand dimensions in the small range. Likewise, handwear sized as "medium" and "large" should be distributed. If more than one handwear item is being tested, then the sizing process should be repeated for each item.

Test conditions as described in sections 3.11.4 and 3.11.5 of Part I should comprise one control condition where the dexterity test is performed without handwear plus one condition for each handwear item. Each test participant should be tested on each handwear item and without handwear. Testing should be conducted using an order of presentation as described in section 3.11.5. Participants in one group should be tested simultaneously to the extent that sufficient numbers of dexterity test materials and handwear size ranges are available. Otherwise, testing should be conducted successively. When testing is simultaneous, participants should be prevented from seeing the test boards of other participants. Where testing is successive, those waiting should not be able to watch personnel conducting the test.

b. Temperature Assessment A group of not less than 10 test participants should be used for the test. Each participant should be qualified to operate the equipment if the equipment or system is to be operated during the test. If the item under test is the enclosure itself, such as a tent, command post or building where operations vary according to the use of the enclosure, participants can be given any task, even reading, as long as their hands remain uncovered for a two-hour period. The participant will enter the enclosure, start up the heater, and perform assigned activities during a two-hour period. Dexterity scores will be obtained in a warm enclosure prior to the exposure to the test enclosure, and again after the two hours of barehanded activity in the test enclosure.

c. Clothing/Equipment Assessment A group of not less than 10 participants is required for each clothing/equipment condition. Each participant will complete the CRTC Handwear Testing Course at least once in each clothing/equipment condition.

5.19.4.3 Test Conduct

a. Handwear Assessment In this test, participants will perform the hand dexterity test wearing experimental handware, standard handwear, and no handware. Each participant will perform the test as many times as there are control and experimental conditions and the dexterity score for the participants will be the mean under each condition.

b. Temperature Assessment Each participant will complete one dexterity test in a controlled warm environment with ambient temperature of 75° to 80°F (24° to 27° C). The participant then will occupy the test enclosure conducting activities requiring use of the bare hands. After two hours in the test enclosure, a dexterity test will be completed while still in the enclosure.

c. Clothing/Equipment Assessment All test participants will complete the dexterity test in a controlled environment with the ambient temperature between 70° and 80°F (21° to 27°C). The participants will then don experimental or test clothing or equipment and complete the CRTC Handwear Testing Course. Immediately on completing the course, participants will complete a second dexterity test in the controlled environment.

5.19.5 Data Required

a. Handwear Assessment Dexterity scores with each handwear configuration identified by size of handwear (large, medium or small).

b. Temperature Assessment Dexterity scores at the beginning and end of a two-hour period in the test enclosure.

c. Clothing/Equipment Assessment Differences in dexterity scores prior to and after completing the CRTC Handwear Testing Course for each clothing/equipment configuration and ambient temperatures.

5.19.6 Data Reduction and Presentation

a. Handwear Assessment The average dexterity scores for each handwear configuration subgroup will be determined as well as standard deviations about these means. The mean dexterity scores for each handwear condition and the control condition will then be compared by means of t tests. The results of these comparisons will be presented in tabular form.

b. Temperature Assessment t tests will be used to determine whether the differences between mean dexterity scores obtained before and after the two-hour period in the enclosure are significant. The results will be presented in tabular form.

c. Clothing/Equipment Assessment A dexterity decrement will be computed for each participant as the difference in dexterity scores before and after completion of the CRTC Handwear Testing Course. The average decrement will

be computed for each clothing/equipment condition, and t tests will be used to compare the differences in group means. These data will be presented in tabular form.

5.20 TEST PROCEDURE
COLD REGIONS CLOTHING AND EQUIPMENT

5.20.1 Objective This procedure is intended to provide guidance on methods and measures to be used in assessing clothing and personal equipment worn in the cold environment.

5.20.2 Criteria Criteria will be established by the development agency in the following general areas:

a. Mobility Range of motion available when critical to job performance.

b. Endurance Duration item is to be worn without producing significant fatigue.

c. Performance Levels of performance capability of personnel wearing items of clothing or personal equipment.

d. Comfort Prevalence of favorable comments concerning comfort and fit.

e. Clearance Minimum acceptable effect of the item on clearance of body or limb.

f. Preparation Time to prepare, configure, don and doff.

g. Compatibility Capability to effectively wear and use other equipment while wearing cold region clothing/equipment.

Criteria will also include restriction on range of movement of head and limbs as described in Figure 2-14 and Table 2-11 of MIL-HDBK-759A(MI). Depending on the nature of the test item, certain test procedures described in section 5 of Part I may be appropriate. These are identified throughout section 5.20 and the criteria for these tests will be as defined for the test procedure in the appropriate paragraphs of section 5. Additional criteria and test methods are contained in TOPs which are listed in Appendix F of Part I. Apendix D of Part I lists expected effects of cold on task performance.

5.20.3 Facilities and Instrumentation

5.20.3.1 Facilities Some of the tests described herein will require use of the CRTC Combat Effectiveness Course.

5.20.3.2 Instrumentation Instrumentation required for individual tests will be as described in the appropriate paragraphs of test procedures in section 5.

5.20.4 Method

This procedure addresses four types of clothing or equipment: (1) that worn on the body, (2) that worn on the head, (3) that worn on the hand, and (4) that worn on the foot. It must be emphasized that this procedure addresses the human factors engineering aspects of clothing/equipment tests. Such tests are primarily concerned with the effects of the test items on human performance and comfort. Questions of wear, permeability, and effectiveness in protecting body members from the cold may be assessed using

questionnaire and interview items which address item comfort as described in section 5.18 of Part I.

5.20.4.1 General Guidelines The test measures to be employed for each of these areas of concern for each of the types of clothing and equipment to be tested are as follows:

5.20.4.1.1 Bodywear

a. Mobility Measure effects of clothing on reach capability when critical to job performance.

b. Endurance Measure fatiguing effects of wearing the clothing or equipment.

c. Performance Measure the effects of the clothing/equipment on the wearer's capability of performing representative combat activities.

d. Comfort Obtain opinions of wearers data concerning, at a minimum, comfort, warmth, and fit.

e. Clearance Observe operations performed by personnel wearing test items, and measure body dimensions with the items worn.

f. Preparation Measure time to setup, configure, don and doff under daylight, night time, blackout, and whiteout conditions.

g. Compatibility Observe personnel, while wearing the test items, perform typical tasks with other clothing and equipment.

5.20.4.1.2 Headwear

a. Mobility Measure limits of head rotation as it affects visual access to components while wearing the item.

b. Endurance Obtain opinions of wearers concerning fatigue effects of wearing the item.

c. Performance Measure visual field of view and/or aural acuity with item in place.

d. Comfort Obtain opinions of wearers concerning, at a minimum, the item weight, comfort, warmth, and fit.

e. Clearance Observe normal operations wearing the item and measure impact on head clearance limits.

f. Preparation Measure time to unstow, setup, configure, don and doff under daylight, night time, blackout, and whiteout conditions.

g. Compatibility Observe personnel, while wearing the test items, perform typical tasks with other equipment such as helmets, optical systems, etc.

5.20.4.1.3 Handwear

a. Mobility Measure limits of wrist rotation capability.

b. Endurance Obtain opinions of wearers concerning fatigue induced from wearing the item.

c. Performance Measure manual dexterity wearing the item.

d. Comfort Obtain opinions of wearers concerning, at a minimum, the item comfort, fit, warmth, and waterproofing.

e. Clearance Measure effect of the item on hand access limits.

f. Preparation Measure time to configure, prepare, don and doff under daylight, night time, blackout, and whiteout conditions.

g. Compatibility Observe personnel, while wearing the test items, perform typical tasks with other equipment such as weapons, tools, etc.

5.20.4.1.4 Footwear

a. Mobility Measure limits of foot rotation capability.

b. Endurance Obtain opinions of wearers concerning fatigue induced from wearing the item.

c. Performance Observe performance of the wearer while performing activities intended while wearing the item (climbing up/down, running, skiing, walking, etc.).

d. Comfort Obtain opinions of wearers concerning, at a minimum, the comfort and fit of the item.

e. Clearance Observe the item use under conditions of limited clearance.

f. Preparation Measure time to unstow, configure, don and doff under daylight, night time, blackout, and whiteout conditions.

g. Compatibility Observe personnel, while wearing the test items, perform typical tasks with other equipment such as foot pedals, stairs, etc.

5.20.4.2 Test Setup and Conduct The test methods associated with each of the measures identified above are as follows:

5.20.4.2.1 Bodywear

a. Mobility Refer to the test procedure on Workspace and Anthropometrics in section 5.6.

b. Endurance Refer to the test procedure on Dexterity in section 5.19.

c. Performance Each of a group of not less than 10 participants will complete the CRTC Combat Effectiveness Course. Mean times to complete the course measured for experimental clothing/equipment conditions will not differ from times obtained for standard conditions, using a "t" test of significance.

d. Comfort Use interviews and/or questionnaires addressing comfort and fit as described in section 5.18.

e. Clearance Conduct task sequences following task checklists developed for assessments of items to be used while wearing the clothing/equipment (vehicle entry, etc.). See the Task Checklists procedure in section 5.17.

f. Preparation Identify tasks involved in preparing and donning/doffing the item as described in section 2.4 of HEDGE and select personnel representative of item users who fall at approximately the 5th and 95th percentiles on critical body dimensions (See section 5.6.). Measure time required for personnel to perform specific tasks.

g. Compatibility Personnel will be observed performing typical tasks with typical equipment while wearing the test item. Incidents of noncompatibility will be noted and described in detail. Test participants will be interviewed as described in section 5.18 to elicit their comments and observations.

5.20.4.2.2 Headwear

a. Mobility Measure angles of head rotation about three axes.

b. Endurance Conduct interviews or administer questionnaires to elicit wearer opinions, attitudes, and comments concerning fatigue as described in section 5.18).

c. Performance Measure the field of view with item in place as described in the Visibility test procedure in section 5.4. Measure auditory acuity using speech intelligibility measurement methods described in section 5.5 with the item in place.

d. Comfort Use interviews and/or questionnaires as described in section 5.18 addressing comfort, fit and warmth of the item .

e. Clearance Observe operations while wearing the item and measure head dimensions with the item in place using head dimensions described in Table 2-9 in MIL-HDBK-759A(MI).

f. Preparation Identify tasks involved in preparing and donning/doffing the item using the Sample Task Checklists in Appendix A of HEDGE, and measure time to perform specific tasks.

g. Compatibility Personnel will be observed performing typical tasks with typical equipment while wearing the test item. Incidents of noncompatibility will be noted and described in detail. Test participants will be interviewed as described in section 5.18 to elicit their comments and observations.

5.20.4.2.3 Handwear

a. Mobility Measure angles of wrist rotation about two axes.

b. Endurance Conduct interviews or administer questionnaires as described in section 5.18 to elicit wearer attitudes concerning fatigue while wearing the item.

c. Performance Refer to the test procedure on Dexterity in section 5.19.

d. Comfort Conduct interviews or administer questionnaires as described in section 5.18 to elicit attitudes and opinions concerning comfort, fit, waterproofing, and warmth.

e. Clearance Measure hand dimensions with the item in place using dimensions described in Table 2-9 in MIL-HDBK-759A(MI).

f. Preparation Identify tasks involved in preparing the item and donning/doffing, using the tasks listed in the appropriate Sample Task Checklists from Appendix A of HEDGE. Measure time to perform specific tasks.

g. Compatibility Personnel will be observed performing typical tasks with typical equipment while wearing the test item. Incidents of noncompatibility will be noted and described in detail. Test participants will be interviewed as described in section 5.18 to elicit their comments and observations.

5.20.4.2.4 Footwear

a. Mobility Measure ankle rotation about two axes.

b. Endurance Conduct interviews or administer questionnaires as described in section 5.18 directed at comments on fatigue.

c. Performance Observe wearers performing selected operations (climbing up a tank, running in deep snow, etc.) and identify problem areas.

d. Comfort Conduct interviews or administer questionnaires as described in section 5.18 directed at comments on comfort, fit, waterproofing, and warmth.

e. Clearance Measure foot size with item in place.

f. Preparation Identify tasks involved in preparing the item and in donning/doffing using the appropriate Sample Task Checklists from Appendix A in HEDGE. Measure time to complete these tasks.

g. Compatibility Personnel will be observed performing typical tasks with typical equipment while wearing the test item. Incidents of noncompatibility will be noted and described in detail. Test participants will be interviewed as described in section 5.18 to elicit their comments and observations.

5.20.5 Data Required

5.20.5.1 Bodywear

a. Mobility Reach measurements compared with criteria.

b. Endurance Dexterity scores before and after completing the CRTC Combat Effectiveness Course with the item in place. Compare mean degradation in dexterity with the test item versus standard clothing or equipment.

c. Performance Time to complete the CRTC Combat Effectiveness Course. Compare mean time to complete with the item in place versus a standard item of clothing/equipment.

d. Comfort Wearer ratings.

e. Clearance Identification of problems.

f. Preparation Time to complete compared with criterion time.

g. Compatibility Identification of problems.

5.20.5.2 Headwear

a. Mobility Neck flexion and rotation limit data compared with normal limits contained in Figure 2-14 and Table 2-11 in MIL-HDBK-759A(MI)

b. Endurance Wearer ratings.

c. Performance Field of view measurements compared with criterion field of view, speech intelligibility scores compared with criterion levels.

d. Comfort Wearer ratings or comments.

e. Clearance Identification of problems.

f. Preparation Measured time compared with required times.

g. Compatibility Identification of problems.

5.20.5.3 Handwear

a. Mobility Wrist rotation angles wearing the item compared with normal limits identified in Figure 2-14 and Table 2-11 in MIL-HDBK-759A(MI).

b. Endurance Wearer ratings.

c. Performance Dexterity scores with test item as compared with standard handwear.

d. Comfort Wearer ratings.

e. Clearance Hand dimensions compared with nude dimensions.

f. Preparation Measured times compared with required times.

g. Compatibility Identification of problems.

5.20.5.4 Footwear

a. Mobility Ankle rotation angles compared with normal limits identified in Figure 2-14 and Table 2-11 in MIL-HDBK-759A(MI).

b. Endurance Wearer ratings and comments.

c. Performance Identification of problems.

d. Comfort Wearer ratings and comments.

e. Clearance Identification of problems.

f. Preparation Measured times compared with required times.

g. Compatibility Identification of problems.

5.20.6 Data Reduction and Presentation

5.20.6.1 Mobility Data Results of mobility assessments in the form of reach envelopes and head, wrist, and ankle angles of rotation, as appropriate, should be presented pictorially.

5.20.6.2 Endurance Data Performance degradation data due to fatigue should be presented in graphic form comparing alternate clothing/equipment configurations. Wearer opinion response frequency data should be presented in tabular form or graphically in the form of bar graphs as described in section 5.18.

5.20.6.3 Performance Data Performance data should be presented in graphic and tabular form.

5.20.6.4 Comfort Data Frequencies of wearer comments or ratings should be presented in tabular or bar graph form as described in section 5.18 for different configurations.

5.20.6.5 Clearance Hand, foot, head and body clearance data with the test item in place should be presented pictorially with tables for summaries.

5.20.5.6 Preparation Mean time to prepare, don and doff should be presented in tabular form.

5.20.5.7 Compatibility Compatibility data should be presented in narrative and pictorial form, if appropriate.

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APPENDIX A

DATA COLLECTION FORMS

This appendix presents a series of blank data collection forms which are used in various aspects of planning an HFE subtest. These forms may be copied and used wherever called for by this TOP.

HFE TEST PLANNING CHECKLIST

Test Title

Test Project No	Date

Step	Description	Outputs	YES	NO	N/A
1	Classify Test Item (1)*	• Item classified			
		• Other relevant item classes identified			
2	Determine Applicable Test Functions (1)	• Operability			
		• Maintainability			
		• Transportability			
		• Portability/Usability			
		• Erectability			
		• Habitability			
3	Identify Use Conditions (2,4,5)	• Applicable use environments identified			
		• Applicable tactical/operating use conditions identified			
		• Applicable operator/maintainer clothing conditions identified			
		• Applicable operator/maintainer body size/dimensions identified			
		• Participant MOS/skill level identified			
		• Test environmental conditions selected			
		• Test tactical/operating conditions selected			
		• Test operator clothing conditions selected			
		• Test participant body size dimensions selected			

* Code numbers indicate regulatory or guidance documents:
  1 = HEDGE (Part II of TECOM TOP 1-2-610)
  2 = Test Item IAP, IEP, or TDP
  3 = AR 602-1
  4 = Test Item Requirements Documents
  5 = Test Item Technical Manuals

HFE TEST PLANNING CHECKLIST

Step	Description	Outputs	YES	NO	N/A
4	Identify/Analyze Operator/ Maintainer Tasks (1,2,3,4,5)	• Task sequences determined			
		• Critical tasks identified			
		• Task requirements identified			
		• Operational sequence diagrams completed			
		• Task analysis completed			
		• Task checklists completed to include critical tasks in proper sequence			
5	Conduct Preliminary HFE Analysis (1,2,4,5)	• Potential HFE problems identified			
		• HFE tests selected			
		• HFE data requirements identified			
		• Test conditions selected			
		• Test facility/instrumentation/ capability limits identified			
6	Identify Design Test Criteria (1,2,4)	• Design test criteria selected			
		• Performance tests selected			
		• Environmental test criteria selected			
7	Select Test Procedcures (2,3)	• Lighting			
		• Noise Measurement			
		• Temperature, Humidity, Vent.			
		• Visibility			
		• Speech Intelligibility			
		• Workspace & Anthropometrics			
		• Force/Torque			
		• Design Checklists prepared			
		• Panel Commonality Analysis			
		• HFE Maintainability			
		• Individual Performance test			
		• Error Likelihood Analysis			
		• Crew Performance test			
		• Information System test			
		• NET Training Assessment			
		• Workload Analysis			
		• Task Checklists prepared			
		• Questionnaire/Interview			
		• Dexterity test			
		• Cold Regions tests identified			
8	Develop Questionnaires and Interviews (3)	• Questions & contents identified			
		• Questionnaire/Interview forms prepared			

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HFE TEST PLANNING CHECKLIST

Step	Description	Outputs	YES	NO	N/A
9	Identify Test Participants (2,5)	• Number and types of participants selected			
		• Number by body dimension/size selected			
		• Number by gender selected			
		• Summary activity screening established			
		• Minimum skills, MOS, grade identified			
10	Identify Test Facility & Instrumentation Requirements (1,2)	• Test facility requirements identified			
		• Test support requirements identified			
		• Test instrumentation rquirements identified			
		• Test materials requirements identified			
		• Test data collection requirements identified			
11	Identify Test Controls	• Test participant controls identified			
		• Test procedures controls identified			
		• Competitive item controls identified			
		• Participant assignment controls identified			
		• Order of presentation controls identified			
12	Develop Test Plan	• Test plan completed			
		• Objectives			
		• Criteria			
		• Data Required			
		• Data Acquisition Procedure			
		• Technical Assessment			
		• Test Plan reviewed/revised			

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PRELIMINARY HFE ANALYSIS

Test item		Test Title	
Station		Test Project No.	Date
		Evaluator	

Selected Tasks from Task Analysis	Factors to be Analyzed in the HFE Subtest			
	Environmental Conditions	Equipment Characterstics	Test Participant Characteristics	Performance Measures

TASK CHECKLIST

Test Function - Checklist
Item Class - Subclass
Function
Subfunction
Abbreviation

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N / A	Comment

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist
Item Class - Subclass
Function
Subfunction
Abbreviation

Soldier/Item Tasks	YES	NO	N/A	Comment

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components
HF Considerations
Abbreviation

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N/A	Comment

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components
HF Considerations
Abbreviation

Detailed Design Considerations	YES	NO	N / A	Comment

YES = Adequate NO = Inadequate N/A = Not Applicable

PANEL COMMONALITY ANALYSIS

Panel A		Test Title	
Panel B		Test Project No.	Date
System		Evaluator	

Control/ Display	Presence		Characteristics							Comment
	Unique	Present on Both*	Location	Type	Size	Label	Arrange	Color	Operate	

* If not unique and present on only one panel - indicate that panel as A or B.

WORKLOAD ASSESSMENT

Test Item		Test Function		Test Title	
Station				Test Project No.	Date
Conditions				Evaluator	

Critical Task	Time Required	Other Concurrent Tasks	Effect of Delays in Task Completion	Overload Problems	Underload Problems	Comment

CONTROL ERROR LIKELIHOOD WORKSHEET

Test Item ________ Test Title ________

Console ________ Test Project No. ________ Date ________

Evaluator ________

Control Name	Errors*: Inadvertent Actuation	Substitution	Sequence	Activation	Temporal	Overall Rating*	Error Criticality: Likelihood of Detection &Correction*	Consequences of Error	Criticality Rating*	Comment

*Ratings: 3 = High 2 = Moderate 1 = Low

DISPLAY ERROR LIKELIHOOD WORKSHEET

Test Item ______ Test Title ______

Console ______ Test Project No. ______ Date ______

Evaluator ______

Display Name	Errors*					Error Criticality			
	Substitution	Reading	Interpretation	Temporal	Overall Rating*	Likelihood of Detection & Correction*	Consequences of Error	Criticality Rating*	Comment

*Ratings: 3 = High 2 = Moderate 1 = Low

ERROR REPORT

Task from Task Analysis		Test Title	
		Test Project No.	Date
Error Report No.		Evaluator	

1. Description of Error
Describe exactly what the person did or failed to do that resulted in the error.
Describe exactly the equipment, components, or tools involved.
Explain what was supposed to be done or the task required.

2. Factors Contributing to the Error
Describe lack of information, design problem, time pressure, weather, hazards, etc.

3. Consequences of the Error
Describe effects on personnel safety, mission success, equipment damage, etc.

4. Criticality of the Error

Hazard	Degraded Performance	Operator Recovery	Other (describe)
☐ to personnel	☐ of system	☐ not detectable	
☐ to equipment	☐ of subsystem	☐ not reversible	
	☐ of component		

5. Corrective Action Taken

6. Error Likelihood
The chance of this error occurring in a real operational or combat situation is:

☐ less likely ☐ about the same ☐ more likely

Why (explain)

7. Suggestions for Eliminating or Reducing Error Likelihood
Consider changes in procedures, training, environment, warning labels, hardware, etc.

PERSONNEL DATA

Test Location

Test Title

Test Project No.

Date

A. To be Completed by Test Participant

1. Name
2. Grade
3. Date
4. Sex
5. MOS
6. ID No.
7. Crew Position (in the test)
8. Months of Experience (in tested crew position)
9. Height
10. Weight
11. Date of Birth
12. Place of Birth
13. Length of Service ____ years ____ months
14. Handedness
15. Civilian Education ____ years Major Area (if applicable)

B. To be Completed for each Test Participannt by Test Supervisory Personnel

16. Physical Profile

P	U	L	H	E	S

17. Aptitude Scores

	a. C O	b. F A	c. E L
d. O F	e. G M	f. MM	g. C L
h. S T	i. G T	j. S C	k. E I
l. G I	m. C I	n. A D	o. S K
p. T I	q. A I	r. A P	s. P A
t. MK	u. WK	v. A R	w. M C

18. Latest SQT Test Score
19. End-of-Training Test Score
20. Minimum Performance required ____ attained ____
21. List of Military Schools and Courses Completed

NET ANALYSIS QUESTIONNAIRE

Evaluated by (Name)	First	MI	Last	Date (Day Mo Yr)
Rank/Grade		MOS/Job Title		Experience (Yrs Mos)

Related Training

Related Experience

Test Title

Course (Circle): Operator Organizational DS/GS Other

Instructions: Circle a number between the adjectives which best represents your opinion of the instruction you have received during this evaluation period.

A. Instructors

1. Used jargon or confusing terms	Never	1	2	3	4	5	6	7	8	9	Always
2. Speaking ability (enunciation, volume, etc.)	Poor	1	2	3	4	5	6	7	8	9	Excellent
3. Subject knowledge	Poor	1	2	3	4	5	6	7	8	9	Excellent
4. Treatment of Students	Discourteous	1	2	3	4	5	6	7	8	9	Courteous
5. Aware of student understanding of subject material	Never	1	2	3	4	5	6	7	8	9	Always
6. Preparation of instruction	Poor	1	2	3	4	5	6	7	8	9	Excellent
7. Response to student questions	Poor	1	2	3	4	5	6	7	8	9	Excellent
8. Overall rating	Unsatisfactory	1	2	3	4	5	6	7	8	9	Outstanding

B. Instruction

1. Basic concepts were made clear at beginning of block of instruction	Never	1	2	3	4	5	6	7	8	9	Always
2. Basic concepts were developed logically	Never	1	2	3	4	5	6	7	8	9	Always
3. Presentation of material was	Boring	1	2	3	4	5	6	7	8	9	Interesting
4. Classrom discussions were	Waste of time	1	2	3	4	5	6	7	8	9	Valuable
5. Material was presented	Too slowly	1	2	3	4	5	6	7	8	9	Too rapidly
6. Coverage of material was	Too superficial	1	2	3	4	5	6	7	8	9	Too technical
7. Training aids were	Poor	1	2	3	4	5	6	7	8	9	Excellent
8. Training aids were used	Too seldom	1	2	3	4	5	6	7	8	9	Too often
9. Lectures/conferences led into PEs	Never	1	2	3	4	5	6	7	8	9	Always

NET ANALYSIS QUESTIONNAIRE

C. Practical Exercises (PE)

1. Time scheduled for PEs was	Inadequate	1	2	3	4	5	6	7	8	9	Adequate
2. PEs were conducted on actual hardware	Never	1	2	3	4	5	6	7	8	9	Always
3. All students participated in PEs	Never	1	2	3	4	5	6	7	8	9	Always
4. PEs were conducted as scheduled	Never	1	2	3	4	5	6	7	8	9	Always
5. What percentage of the instruction time was "hands on' for you?		10	20	30	40	50	60	70	80	90	

D. Lesson Assignments and References

1. Assignments were necessary	Never	1	2	3	4	5	6	7	8	9	Always
2. Assignments were	Too simple	1	2	3	4	5	6	7	8	9	Too difficult
3. Manuals and reference materials were	Too elementary	1	2	3	4	5	6	7	8	9	Too difficult
4. Manuals and reference materials were designed for easy use	Never	1	2	3	4	5	6	7	8	9	Always

E. Examinations

1. Material covered in exams was presented during instruction/PE	Never	1	2	3	4	5	6	7	8	9	Always
2. Exams were	Too short	1	2	3	4	5	6	7	8	9	Too long
3. Exams were	Too simple	1	2	3	4	5	6	7	8	9	Too dificult
4. Performance-type exams were given	Never	1	2	3	4	5	6	7	8	9	Always
5. Exams tested knowledge of material presented during instruction/PE	Not at all	1	2	3	4	5	6	7	8	9	Completely

F. Comments

Please make any narrative comments you desire. Suggested areas for comment are superior or unsatisfactory instruction, estimates of value of the instruction to your job, or recommended additions and deletions to the course content.

____

____

____

____

TRAINING/DEBRIEFING QUESTIONNAIRE

Name ______ Test Title ______

Grade/Rank ______ Test Project No. ______ Date ______

1. List your military occupational specialty (MOS). ______
2. How long have you had this MOS? ______

   Years Months
3. In the space below, list the school training you have had in this MOS.
4. Which test item component did you use? ______
5. Did you encounter any problems during the test which you attribute to insufficient training? If yes, explain. Yes ☐ No ☐
6. Did you understand all phases of your training? If no, explain. Yes ☐ No ☐

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TRAINING/DEBRIEFING QUESTIONNAIRE

7. Do you think it takes any special skills to operate the equipment you used? If yes, state special skills. Yes ☐ No ☐

8. Would you like any additional trianing on the test item before you are assigned to operate it in a tactical unit? If yes, specify additional training. Yes ☐ No ☐

9. State in your own words how your training could be improved.

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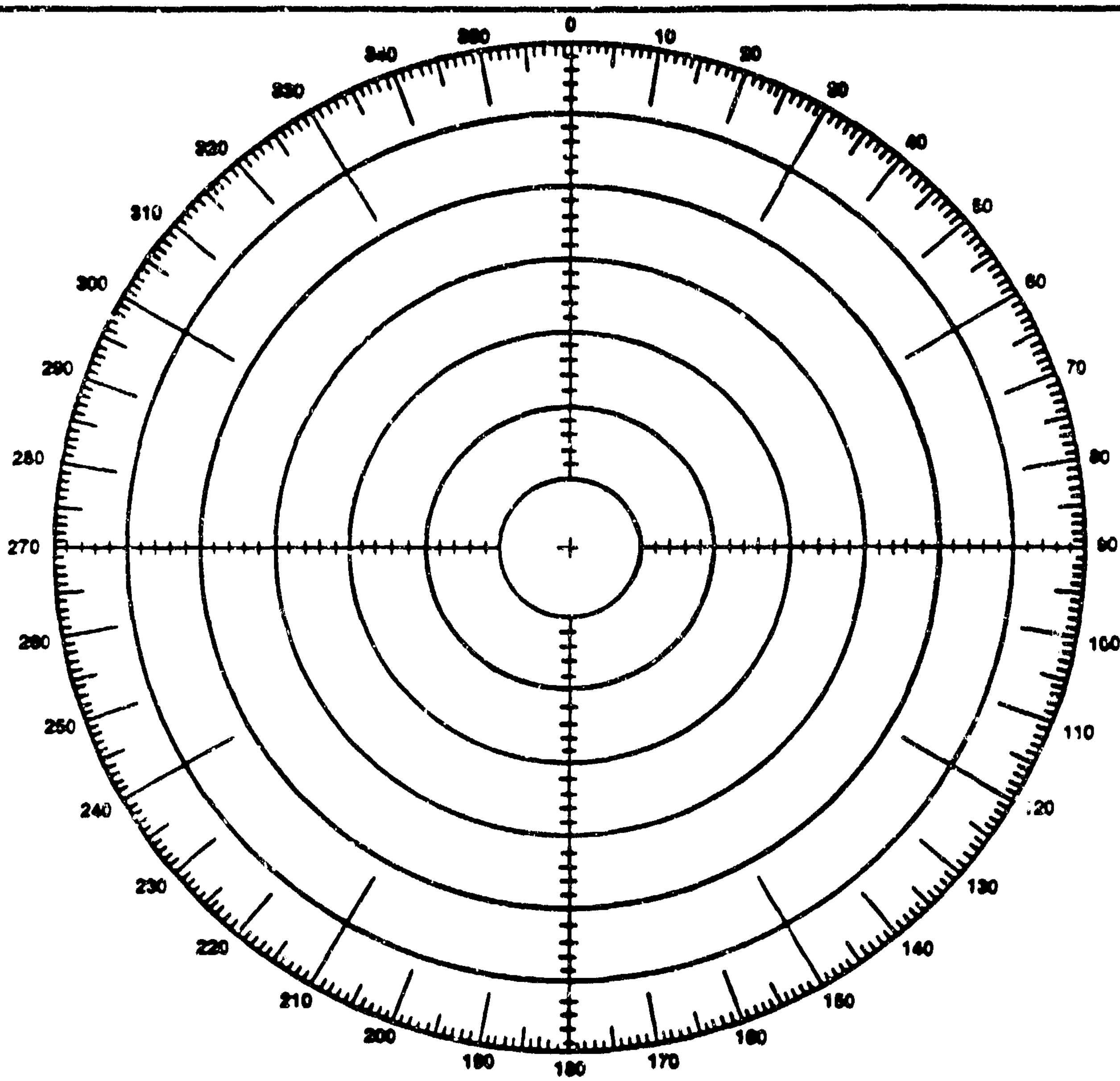
VISIBILITY CONTOUR MAP



TEST ITEM:	DATE:
STATION:	TESTER:
TOTAL UNOBSTRUCTED VIEW:	MINIMUM DISTANCE 0°
REMARKS:	

APPENDIX B

SAMPLE QUESTIONNAIRES AND INTERVIEWS

This appendix presents sample questionnnaire and interview questions and formats. Because these are highly specific to certain test items and test item characteristics, they cannot be used directly. They are presented only as a guide to typical questions, structure, and format.

SAMPLE INTERVAL SCALES

Name		Grade/Rank		Date	
MOS		Time in MOS			

1. How do you rate the adequacy of the test item?
(Circle one.)

Extremely Good	Very Good in Most Respects	Moderately Good	Barely Adequate	Very Poor	Extremely Poor
6	5	4	3	2	1

Comments

2. How do you rate the comfort associated with using the test item?
(Circle one.)

Excellent Comfort	Comfort Is Very Satisfactory	About Average In Comfort	Slightly Uncomfortable	Very Uncomfortable	So Uncomfortable It Can Barely Be Worn
6	5	4	3	2	1

Comments

3. How do you rate the ease of operating the test item?
(Circle one.)

Extremely Easy	Very Easy	Easy	Difficult	Very Difficult	Extremely Difficult
6	5	4	3	2	1

Comments

SAMPLE INTERVAL SCALES

4. How do you rate the overall acceptability of the test item? (Circle one.)

Completely Acceptable	Reasonably Acceptable	Borderline	Moderately Unacceptable	Extremely Unacceptable
5	4	3	2	1

Comments

SAMPLE SELF-ADMINISTERED QUESTIONNAIRE

Lightweight Company Mortar System (LWCMS)

Name		Grade/Rank		Date	
MOS		Time in MOS			

The purpose of this questionnaire is to obtain your opinions of the Lightweight Company Mortar System (LWCMS). Since you have participated in the firing of the LWCMS, your opinions and comments are extremely important. Please answer all of the following questions as honestly and accurately as you can. Each question provides space for you to give any additional comments or information which you feel may be helpful.

1. In your opinion, is the LWCMS a safe weapon system to handle and fire? (Check one.)

   ☐ Yes
   ☐ No

   Comments

2. Did you ever have malfunctions which caused a mission delay with the LWCMS? (Check one.)

   ☐ Yes
   ☐ No

   Comments

3. Compared to the 81mm Mortar, how easy or difficult was it to emplace the LWCMS? (Check one.)

   ☐ Much easier
   ☐ Slightly easier
   ☐ About the same
   ☐ Slightly more difficult
   ☐ Much more difficult

   Comments

SAMPLE SELF-ADMINISTERED QUESTIONNAIRE

Lightweight Company Mortar System (LWCMS)

4. Did you detect any residual flour remaining after the round was fired with the LWCMS? (Check one.)

- [ ] Yes
- [ ] No

Comments

5. Compared to the 81mm Mortar, how easy or difficult was it to load the round into the tube of the LWCMS? (Check one.)

- [ ] Much easier
- [ ] Slightly easier
- [ ] About the same
- [ ] Slightly more difficult
- [ ] Much more difficult

Comments

SAMPLE INTERVIEW GUIDE

Test of Composite Body Armor

Name		Grade/Rank		Date	
MOS		Time in MOS			

Test Phase (Circle one.) I II III IV

Instructions

Interview each test participant separately and apart from all others. Have a sample of each type of body armor within view of the participant. Provide a copy of the interview guide to the participant so he/she can follow the questions and see the choice of responses during the interview.

1. Which type of body armor did you wear during the past 3-day wear phase? (Check one.)

   ☐ Type S
   ☐ Type E

2. What types of test activities did you participate in during this wear phase? (Check one.)

   ☐ Simulated assault
   ☐ Road march
   ☐ Cross-country march
   ☐ Night patrol
   ☐ Weapons firing

3. a. Did you experience any difficulty in performing any of the test activities while wearing this type of body armor? (Check one.)

   ☐ Yes
   ☐ No

   b. If Yes, then ask "What seemed to be the trouble?". (Describe in detail.)

   ___
   ___
   ___

SAMPLE INTERVIEW GUIDE

Test of Composite Body Armor

4. a. How would you rate this type of body armor with regard to comfort? (Check one.)

- ☐ Excellent comfort
- ☐ Comfort is very satisfactory
- ☐ About average in comfort
- ☐ Slightly uncomfortable
- ☐ Very uncomfortable at times
- ☐ So uncomfortable it can barly be worn

b. If any "uncomfortable" category is selected, then ask "What do you feel caused it to be uncomfortable?". (Describe in detail.)

____

____

____

5. a. How would you rate the fit of this type of body armor? (Check one.)

- ☐ Fits extremely well
- ☐ Fit is quite satisfactory
- ☐ Fit is about average
- ☐ Fit needs improving
- ☐ Fit is not very satisfactory
- ☐ Fit is very poor

b. If fit is considered to be less than "about average", then ask "What seemed to be the problem with the fit of the armor?". (Describe in detail.)

____

____

____

SAMPLE INTERVIEW GUIDE

Test of Composite Body Armor

6. a. How would you rate the degree of freedom of movement afforded by this type of body armor? (Check one.)

- [ ] Excellent
- [ ] Very good
- [ ] Adequate
- [ ] Not quite adequate
- [ ] Poor
- [ ] Extremely poor

b. If freedom of movement is considered to be less than "Adequate", then ask "What seemed to be the problem?". (Describe in detail.)

____

____

____

NOTE: Ask the following questions only after Phases II and IV.

7. a. Now that you have experienced wear of both the Type S and Type E body armor, which type would you prefer to wear in a combat situation?
(Check one.)

- [ ] Type S
- [ ] Type E
- [ ] Either type

b. If Type S or Type E is selected then ask "Why would you prefer this type?". (Describe in detail.)

____

____

____

APPENDIX C-1

PHONETICALLY BALANCED WORD LISTS

In this appendix are presented 20 phonetically balanced word lists, each consisting of 50 common English monosyllables arranged in alphabetical order. In the event that the same lists have to be presented to the same listeners more than once, the words should be arranged in a different random order for each presentation. If the PB word lists are used, all 20 word lists must be used to avoid erroneous results. The words are presented at a standardized rate of one word every four seconds.

Score each recorded word on its phonetic agreement with the corresponding word on the talker's list. The percentage of words heard correctly is called the "percent word articulation" or the "percent word intelligibility".

PB-50 List 1

1.	cane	26.	pest
2.	there	27.	slip
3.	dish	28.	rub
4.	hid	29.	feast
5.	heap	30.	deed
6.	pants	31.	cleanse
7.	hunt	32.	folk
8.	no	33.	nook
9.	bar	34.	mange
10.	pan	35.	such
11.	fuss	36.	use (yews)
12.	creed	37.	crash
13.	box	38.	ride
14.	strife	39.	pile
15.	dike	40.	rat
16.	not	41.	rag
17.	ford	42.	is
18.	end	43.	wheat
19.	then	44.	rise
20.	bask	45.	hive
21.	fraud	46.	grove
22.	smile	47.	toe
23.	death	48.	plush
24.	are	49.	clove
25.	bad	50.	fern

PB-50 List 2

1.	tang	26.	blush
2.	fate	27.	nab
3.	suck	28.	bait
4.	else	29.	bud
5.	pit	30.	rap
6.	gill	31.	moose
7.	charge	32.	trash
8.	bought	33.	gloss
9.	cloud	34.	perk
10.	mute	35.	vamp
11.	bean	36.	start
12.	scythe	37.	earl
13.	vast	38.	corpse
14.	rib	39.	sludge
15.	pick	40.	tan
16.	hock	41.	ways
17.	our	42.	bounce
18.	hit	43.	niece
19.	job	44.	awe
20.	wish	45.	them
21.	nut	46.	need
22.	dab	47.	quart
23.	frog	48.	give
24.	log	49.	hire
25.	snuff	50.	shoe

PB-50 List 3

1.	why	26.	size
2.	turf	27.	wedge
3.	gnaw	28.	deck
4.	drop	29.	hurl
5.	jam	30.	wharf
6.	flush	31.	leave
7.	rouse	32.	crave
8.	neck	33.	vow
9.	sob	34.	law
10.	trip	35.	stag
11.	dill	36.	oak
12.	thrash	37.	nest
13.	dig	38.	sit
14.	rate	39.	crime
15.	far	40.	muck
16.	check	41.	fame
17.	air	42.	take
18.	bead	43.	who
19.	sped	44.	toil
20.	cast	45.	path
21.	class	46.	pulse
22.	lush	47.	fig
23.	shout	48.	barb
24.	bald	49.	please
25.	cape	50.	ache

PB-50 List 4

1.	float	26.	new
2.	sage	27.	rut
3.	cloak	28.	neat
4.	race	29.	dodge
5.	tick	30.	sketch
6.	touch	31.	merge
7.	hot	32.	bath
8.	pod	33.	court
9.	frown	34.	oils
10.	rack	35.	shin
11.	bus	36.	peck
12.	blonde	37.	beast
13.	pert	38.	heed
14.	shed	39.	eel
15.	kite	40.	move
16.	raw	41.	earn
17.	hiss	42.	budge
18.	fin	43.	sour
19.	scab	44.	rave
20.	how	45.	bee
21.	strap	46.	bush
22.	slap	47.	test
23.	pinch	48.	hatch
24.	or	49.	course
25.	starve	50.	dupe

PB-50 List 5

1.	feed	26.	sly
2.	gape	27.	wrath
3.	sick	28.	love
4.	Greek	29.	beck
5.	roe	30.	thick
6.	choose	31.	flap
7.	true	32.	cheat
8.	pass	33.	wink
9.	browse	34.	zone
10.	punt	35.	odds
11.	shove	36.	kid
12.	hill	37.	trade
13.	black	38.	scare
14.	high	39.	mast
15.	rind (rīnd)	40.	pipe
16.	vase (vāce)	41.	good
17.	rode	42.	lend
18.	puff	43.	yawn
19.	inch	44.	watch
20.	bronze	45.	thud
21.	solve	46.	tug
22.	bathe	47.	curse
23.	add	48.	owls
24.	rear	49.	nose
25.	shine	50.	grudge

PB-50 List 6

1.	as	26.	badge
2.	pun	27.	cloth
3.	rough	28.	kept
4.	nigh	29.	flop
5.	best	30.	fall
6.	jag	31.	wasp
7.	tongue	32.	ode
8.	hitch	33.	hull
9.	bog	34.	fee
10.	rooms	35.	lag
11.	fowl	36.	thigh
12.	reap	37.	chart
13.	writ	38.	wait
14.	wife	39.	cob
15.	clothes	40.	mash
16.	gage	41.	eyes
17.	forge	42.	raise
18.	prime	43.	deep
19.	scan	44.	shank
20.	grope	45.	ray
21.	sup	46.	gap
22.	slouch	47.	crib
23.	thus	48.	pus
24.	prig	49.	eat
25.	flick	50.	dad

PB-50 List 7

1.	gasp	26.	by
2.	woo	27.	am
3.	though	28.	nine
4.	act	29.	wire
5.	dwarf	30.	aim
6.	scout	31.	shaft
7.	sledge	32.	south
8.	sniff	33.	woe
9.	fling	34.	chop
10.	cook	35.	knit
11.	dope	36.	raid
12.	gun	37.	sin
13.	jug	38.	cut
14.	mud	39.	him
15.	plod	40.	dose
16.	fake	41.	quiz
17.	phase	42.	siege
18.	rash	43.	coast
19.	rich	44.	grade
20.	but	45.	fort
21.	pounce	46.	comes
22.	whiff	47.	off
23.	pig	48.	pent
24.	roar	49.	range
25.	sag	50.	mote

PB-50 List 8

1.	wheeze	26.	bored
2.	roll	27.	slide
3.	look	28.	ease
4.	freak	29.	queen
5.	spice	30.	jell
6.	hum	31.	forth
7.	kill	32.	clod
8.	rot	33.	frock
9.	bind	34.	calf
10.	food	35.	guess
11.	bid	36.	shack
12.	night	37.	yeast
13.	pint	38.	cod
14.	thread	39.	crack
15.	this	40.	bolt
16.	catch	41.	dumb
17.	chew	42.	flip
18.	us	43.	each
19.	till	44.	wig
20.	rest	45.	rope
21.	rod	46.	lick
22.	fad	47.	left
23.	chant	48.	deuce
24.	front	49.	ask
25.	day	50.	rhyme

PB-50 List 9

1.	arch	26.	with
2.	year	27.	noose
3.	fluff	28.	fume
4.	phone	29.	rude
5.	crowd	30.	hoof
6.	lit	31.	foe
7.	gate	32.	club
8.	pact	33.	fuse
9.	thank	34.	mass
10.	chest	35.	sip
11.	weak	36.	ten
12.	throne	37.	ditch
13.	than	38.	give
14.	reed	39.	spud
15.	birth	40.	toad
16.	itch	41.	troop
17.	boost	42.	beef
18.	carve	43.	cud
19.	key	44.	root
20.	nuts	45.	bit
21.	odd	46.	ice
22.	chess	47.	grace
23.	wipe	48.	clown
24.	flag	49.	smart
25.	wild	50.	nerve

PB-50 List 10

1.	goose	26.	ail
2.	slug	27.	youth
3.	rape	28.	etch
4.	nudge	29.	put
5.	page	30.	cue
6.	rip	31.	line
7.	hat	32.	force
8.	valve	33.	plus
9.	fir	34.	tag
10.	cow	35.	clothe
11.	flight	36.	wake
12.	maze	37.	cord
13.	those	38.	scrub
14.	staff	39.	void
15.	rush	40.	mope
16.	snipe	41.	champ
17.	ears	42.	lap
18.	gull	43.	flaunt
19.	earth	44.	pink
20.	bash	45.	daub
21.	jay	46.	real
22.	bug	47.	bob
23.	thug	48.	chance
24.	tree	49.	wade
25.	back	50.	hurt

PB-50 List 11

1.	clash	26.	most
2.	latch	27.	shot
3.	shop	28.	rice
4.	net	29.	have
5.	jab	30.	probe
6.	pond	31.	sign
7.	drake	32.	crutch
8.	feel	33.	frisk
9.	doubt	34.	dip
10.	loss	35.	hog
11.	beam	36.	sap
12.	purse	37.	punk
13.	bliss	38.	mouth
14.	lag	39.	fudge
15.	chunk	40.	reef
16.	code	41.	spy
17.	urge	42.	arm
18.	sprig	43.	arc
19.	kit	44.	wood
20.	wave	45.	jaunt
21.	goat	46.	stiff
22.	low	47.	fine
23.	cry	48.	risk
24.	snow	49.	dull
25.	tab	50.	prod

PB-50 List 12

1.	ball	26.	gnash
2.	chink	27.	chafe
3.	dime	28.	vine
4.	cling	29.	wove
5.	tile	30.	sky
6.	jazz	31.	and
7.	rove	32.	greet
8.	frill	33.	wage
9.	priest	34.	ass
10.	foot	35.	flood
11.	laugh	36.	jaw
12.	set	37.	fought
13.	lash	38.	ripe
14.	clutch	39.	hunch
15.	chair	40.	loose
16.	cave	41.	fed
17.	hug	42.	flog
18.	romp	43.	ledge
19.	knife	44.	jolt
20.	chap	45.	done
21.	reek	46.	out
22.	depth	47.	bluff
23.	shut	48.	hear
24.	sod	49.	cad
25.	park	50.	throb

PB-50 List 13

1.	corn	26.	stead
2.	climb	27.	elk
3.	jig	28.	hack
4.	fold	29.	pelt
5.	grave	30.	elm
6.	thin	31.	bean
7.	dog	32.	plead
8.	hook	33.	nice
9.	soap	34.	deaf
10.	grape	35.	tap
11.	wean	36.	smash
12.	few	37.	scuff
13.	taint	38.	ought
14.	smooth	39.	for
15.	price	40.	nag
16.	side	41.	made
17.	fill	42.	nip
18.	hate	43.	mush
19.	mood	44.	muff
20.	moth	45.	mop
21.	my	46.	bat
22.	curb	47.	gem
23.	sled	48.	owe
24.	patch	49.	pug
25.	change	50.	tip

PB-50 List 14

1.	howl	26.	life
2.	lathe	27.	clip
3.	me	28.	darn
4.	nick	29.	heat
5.	coax	30.	shook
6.	at	31.	car
7.	foam	32.	isle
8.	quack	33.	dash
9.	stuff	34.	dung
10.	rid	35.	barn
11.	bust	36.	group
12.	tray	37.	shrug
13.	slab	38.	oft
14.	purge	39.	curve
15.	vague	40.	wag
16.	tent	41.	vote
17.	sing	42.	tell
18.	soil	43.	cute
19.	douse	44.	hunk
20.	fife	45.	smite
21.	nod	46.	thy
22.	kick	47.	grate
23.	prude	48.	waif
24.	news	49.	wrist
25.	muss	50.	dead

PB-50 List 15

1.	dive	26.	time
2.	wed	27.	sir
3.	weave	28.	tack
4.	that	29.	flame
5.	dove (duv)	30.	shade
6.	kiss	31.	cheap
7.	so	32.	less
8.	tinge	33.	elf
9.	ninth	34.	naught
10.	cuff	35.	wide
11.	golf	36.	wreck
12.	gash	37.	fact
13.	bell	38.	morn
14.	glove	39.	jade
15.	scow	40.	mitt
16.	teach	41.	cost
17.	sense	42.	fleet
18.	boss	43.	blind
19.	tweed	44.	mesh
20.	slash	45.	edge
21.	oath	46.	hedge
22.	may	47.	shrub
23.	pup	48.	hole
24.	quick	49.	mode
25.	vile	50.	own

PB-50 List 16

1.	fright	26.	louse
2.	turn	27.	pitch
3.	aid	28.	pump
4.	wield	29.	crews
5.	gab	30.	tuck
6.	rouge	31.	ton
7.	droop	32.	rock
8.	map	33.	suit
9.	hose	34.	dame
10.	stress	35.	tire
11.	rug	36.	thou
12.	book	37.	sheep
13.	leash	38.	stab
14.	cliff	39.	ink
15.	fifth	40.	soar
16.	thresh	41.	three
17.	barge	42.	dub
18.	lay	43.	rye
19.	din	44.	cheese
20.	sheik	45.	kind
21.	part	46.	next
22.	had	47.	closed
23.	sang	48.	gas
24.	knee	49.	drape
25.	hash	50.	nap

PB-50 List 17

1.	all	26.	ma
2.	mist	27.	peg
3.	press	28.	ridge
4.	wine	29.	bet
5.	tube	30.	sell
6.	feet	31.	ship
7.	fit	32.	hence
8.	booth	33.	ox
9.	big	34.	myth
10.	crush	35.	reach
11.	pearl	36.	shock
12.	weep	37.	braid
13.	brace	38.	pare
14.	form	39.	vice
15.	roam	40.	apt
16.	hood	41.	stride
17.	plow	42.	past
18.	if	43.	rage
19.	weird	44.	buck
20.	case	45.	fresh
21.	dart	46.	paid
22.	scratch	47.	fell
23.	you	48.	dine
24.	falls	49.	gum
25.	last	50.	clew

PB-50 List 18

1.	bless	26.	claw
2.	bale	27.	cat
3.	axe	28.	rose
4.	lynch	29.	weed
5.	lunge	30.	his
6.	waste	31.	crab
7.	sack	32.	got
8.	thaw	33.	chip
9.	cub	34.	lime
10.	dice	35.	fool
11.	freeze	36.	thorn
12.	thine	37.	camp
13.	art	38.	dot
14.	grab	39.	rob
15.	lip	40.	loud
16.	ouch	41.	chaff
17.	aims	42.	fade
18.	sieve	43.	sash
19.	hush	44.	hide
20.	gray	45.	debt
21.	grew	46.	claws
22.	trod	47.	fat
23.	chain	48.	flare
24.	note	49.	gush
25.	share	50.	chill

PB-50 List 19

1.	cab	26.	chose (choz)
2.	fan	27.	calve (cav)
3.	find	28.	cant
4.	splash	29.	cage
5.	shy	30.	sill
6.	slid	31.	loose
7.	throat	32.	dune
8.	drug	33.	cup
9.	on	34.	ebb
10.	rule	35.	god
11.	gin	36.	flank
12.	wheel	37.	fond
13.	steed	38.	led
14.	crude	39.	chat
15.	bay	40.	up
16.	rote	41.	bark
17.	raft	42.	hike
18.	yes	43.	paste
19.	yield	44.	sat
20.	lad	45.	age
21.	white	46.	thief
22.	perch	47.	notch
23.	lust	48.	hut
24.	dough	49.	buzz
25.	gyp	50.	bough

PB-50 List 20

1.	in	26.	roost
2.	theme	27.	sigh
3.	web	28.	ace
4.	duke	29.	salve
5.	slice	30.	rout (rowt)
6.	quip	31.	did
7.	retch	32.	tilt
8.	pew	33.	base
9.	pad	34.	pack
10.	wash	35.	gob
11.	gang	36.	hump
12.	fair	37.	soak
13.	get	38.	skid
14.	rouge	39.	slush
15.	ramp	40.	through
16.	lid	41.	flash
17.	seed	42.	robe
18.	judge	43.	fast
19.	walk	44.	mow (mo)
20.	souse	45.	wise
21.	eye	46.	cart
22.	beard	47.	brass
23.	cork	48.	joke
24.	crate	49.	puss
25.	clog	50.	click

APPENDIX C-2

MODIFIED RHYME TEST

This appendix presents 12 lists of rhymed words. There are 50 groups of 6 rhymed words each.

The MRT is scored by: (a) counting the number of words correct, and (b) determining the percent words correct according to the following formula:

$$\text{Percent Correct} = \left[\text{No. Correct} - \frac{\text{No. Wrong}}{5}\right] \times 2$$

This formula is required to correct the word score for chance or guessing made possible by the multiple-choice format of the answer sheet.

LIST 1X

1	lick	pick	tick	wick	sick	kick
2	seat	meat	beat	heat	neat	feat
3	pus	pup	pun	puff	puck	pub
4	look	hook	cook	book	took	shook
5	tip	lip	rip	dip	sip	hip
6	rate	rave	raze	race	ray	rake
7	bang	rang	sang	gang	hang	fang
8	hill	till	bill	fill	kill	will
9	mat	man	mad	mass	math	map
10	tale	pale	male	bale	gale	sale
11	sake	sale	save	same	safe	sane
12	peat	peak	peace	peas	peal	peach
13	king	kit	kill	kin	kid	kick
14	sad	sass	sag	sat	sap	sack
15	sip	sing	sick	sin	sill	sit
16	sold	told	hold	cold	gold	fold
17	buck	but	bun	bus	buff	bug
18	lake	lace	lame	lane	lay	late
19	gun	run	nun	fun	sun	bun
20	rust	dust	just	must	bust	gust
21	pan	path	pad	pass	pat	pack
22	dim	dig	dill	did	din	dip
23	wit	fit	kit	bit	sit	hit
24	din	tin	pin	sin	win	fin
25	teal	teach	team	tease	teak	tear
26	tent	bent	went	sent	rent	dent
27	sung	sup	sun	sud	sum	sub
28	red	wed	shed	bed	led	fed
29	hot	got	not	tot	lot	pot
30	dud	dub	dun	dug	dung	duck
31	pip	pit	pick	pig	pill	pin
32	seem	seethe	seep	seen	seed	seek
33	day	say	way	may	gay	pay
34	rest	best	test	nest	vest	west
35	pane	pay	pave	pale	pace	page
36	bat	bad	back	bath	ban	bass
37	cop	top	mop	pop	shop	hop
38	fig	pig	rig	dig	wig	bip
39	tap	tack	tang	tab	tan	tam
40	cave	cane	came	cape	cake	case
41	game	tame	name	fame	same	came
42	oil	foil	toil	boil	soil	coil
43	fin	fit	fig	fizz	fill	fib
44	cut	cub	cuff	cuss	cud	cup
45	feel	eel	reel	heel	peel	keel
46	dark	lark	bark	park	mark	hark
47	heap	heat	heave	hear	heath	heal
48	men	then	hen	ten	pen	den
49	raw	paw	law	saw	thaw	jaw
50	bead	beat	bean	beach	beam	beak

LIST 2X

1	went	sent	bent	dent	tent	rent
2	hold	cold	told	fold	sold	gold
3	pat	pad	pan	path	pack	pass
4	lane	lay	late	lake	lace	lame
5	kit	bit	fit	hit	wit	sit
6	must	bust	gust	rust	dust	just
7	teak	team	teal	teach	tear	tease
8	din	dill	dim	dig	dip	did
9	bed	led	fed	red	wed	shed
10	pin	sin	tin	fin	din	win
11	dug	dung	duck	dud	dub	dun
12	sum	sun	sung	sup	sub	sud
13	seep	seen	seethe	seek	seem	seed
14	not	tot	got	pot	hot	lot
15	vest	test	rest	best	west	nest
16	pig	pill	pin	pip	pit	pick
17	back	bath	bad	bass	bat	ban
18	way	may	say	pay	day	gay
19	pig	big	dig	wig	rig	fig
20	pale	pace	page	pane	pay	pave
21	cane	case	cape	cake	came	cave
22	shop	mop	cop	top	hop	pop
23	coil	oil	soil	toil	boil	foil
24	tan	tang	tap	tack	tam	tab
25	fit	fib	fizz	fill	fig	fin
26	same	name	game	tame	came	fame
27	peel	reel	feel	eel	keel	heel
28	hark	dark	mark	bark	park	lark
29	heave	hear	heat	heal	heap	heath
30	cup	cut	cud	cuff	cuss	cub
31	thaw	law	raw	paw	jaw	saw
32	pen	hen	men	then	den	ten
33	puff	puck	pub	pus	pup	pun
34	bean	beach	beat	beak	bead	beam
35	heat	neat	feat	seat	meat	beat
36	dip	sip	hip	tip	lip	rip
37	kill	kin	kit	kick	king	kid
38	hang	sang	bang	rang	fang	gang
39	took	cook	look	hook	shook	book
40	mass	math	map	mat	man	mad
41	ray	raze	rate	rave	rake	race
42	save	same	sale	sane	sake	safe
43	fill	kill	will	hill	till	bill
44	sill	sick	sip	sing	sit	sin
45	bale	gale	sale	tale	pale	male
46	wick	sick	kick	lick	pick	tick
47	peace	peas	peak	peach	peat	peal
48	bun	bus	but	bug	buck	buff
49	sag	sat	sass	sack	sad	sap
50	fun	sun	bun	gun	run	nun

LIST 3X

1	gold	hold	sold	told	fold	cold
2	lame	lane	lace	late	lake	lay
3	bust	just	rust	dust	gust	must
4	did	din	dip	dim	dig	dill
5	sin	win	fin	din	tin	pin
6	sun	sud	sup	sub	sung	sum
7	lot	not	hot	got	pot	tot
8	pill	pick	pip	pit	pin	pig
9	may	gay	pay	day	say	way
10	pave	pale	pay	page	pane	pace
11	pop	shop	hop	cop	top	mop
12	tang	tab	tack	tam	tap	tan
13	keel	feel	peel	reel	heel	eel
14	heal	heap	heath	heave	hear	heat
15	paw	jaw	saw	thaw	law	raw
16	pub	pus	puck	pun	puff	pup
17	meat	feat	heat	neat	beat	seat
18	kit	kick	kin	kid	kill	king
19	cook	book	hook	shook	look	took
20	race	ray	rake	rate	rave	raze
21	bill	fill	till	will	hill	kill
22	sap	sag	sad	sass	sack	sat
23	gale	male	tale	pale	sale	bale
24	peas	peal	peach	peat	peak	peace
25	rent	went	tent	bent	dent	sent
26	sun	nun	gun	run	bun	fun
27	bus	buff	bug	buck	but	bun
28	tick	wick	pick	kick	lick	sick
29	sin	sill	sit	sip	sing	sick
30	name	fame	tame	came	game	same
31	safe	save	sake	sale	sane	same
32	map	mat	math	mad	mass	man
33	gang	hang	fang	bang	rang	sang
34	sip	rip	tip	lip	hip	dip
35	beach	beam	beak	bead	beat	bean
36	hen	ten	then	den	men	pen
37	cuff	cuss	cub	cup	cut	cud
38	park	mark	hark	dark	lark	bark
39	fizz	fill	fib	fin	fit	fig
40	soil	toil	oil	foil	coil	boil
41	came	cape	cane	case	cave	cake
42	wig	rig	fig	pig	big	dig
43	ban	back	bat	bad	bass	bath
44	test	nest	best	vest	rest	west
45	seen	seed	seek	seem	seethe	seep
46	dun	dug	dub	duck	dud	dung
47	led	shed	red	wed	fed	bed
48	tease	teak	tear	teal	teach	team
49	bit	sit	hit	wit	fit	kit
50	pad	pass	path	pack	pan	pat

LIST 4X

1	sun	nun	gun	run	bun	fun
2	kit	kick	kin	kid	kill	king
3	bust	just	rust	dust	gust	must
4	pill	pick	pip	pit	pin	pig
5	ban	back	bat	bad	bass	bath
6	rent	went	tent	bent	dent	sent
7	pad	pass	path	pack	pan	pat
8	bill	fill	till	will	hill	kill
9	gang	hang	fang	bang	rang	sang
10	sun	sud	sup	sub	sung	sum
11	pave	pale	pay	page	pane	pace
12	safe	save	sake	sale	sane	same
13	tang	tab	tack	tam	tap	tan
14	gale	male	tale	pale	sale	bale
15	test	nest	best	west	rest	vest
16	pub	pus	puck	pun	puff	pup
17	pop	shop	hop	cop	top	mop
18	name	fame	tame	came	game	same
19	sin	sill	sit	sip	sing	sick
20	sip	rip	tip	lip	hip	dip
21	may	gay	pay	day	say	way
22	sin	win	fin	din	tin	pin
23	soil	toil	oil	foil	coil	boil
24	cuff	cuss	cub	cup	cut	cud
25	wig	rig	fig	pig	big	dig
26	sap	sag	sad	sass	sack	sat
27	tick	wick	pick	kick	lick	sick
28	lot	not	hot	got	pot	tot
29	park	mark	hark	dark	lark	bark
30	seen	seed	seek	seem	seethe	seep
31	dun	dug	dub	duck	dud	dung
32	beach	beam	beak	bead	beat	bean
33	did	din	dip	dim	dig	dill
34	led	shed	red	wed	fed	bed
35	peas	peal	peach	peat	peak	peace
36	tease	teak	tear	teal	teach	team
37	map	mat	math	mad	mass	man
38	came	cape	cane	case	cave	cake
39	keel	feel	peel	reel	heel	eel
40	gold	hold	sold	told	fold	cold
41	paw	jaw	saw	thaw	law	raw
42	race	ray	rake	rate	rave	raze
43	bit	sit	hit	wit	fit	kit
44	fizz	fill	fib	fin	fit	fig
45	lame	lane	lace	late	lake	lay
46	bus	buff	bug	buck	but	bun
47	cook	book	hook	shook	look	took
48	hen	ten	then	den	men	pen
49	meat	feat	heat	neat	beat	seat
50	heal	heap	heath	heave	hear	heat

LIST 5X

1	tan	tang	tap	tack	tam	tab
2	peel	reel	feel	eel	keel	heel
3	coil	oil	soil	toil	boil	foil
4	teak	team	teal	teach	tear	tease
5	hang	sang	bang	rang	fang	gang
6	heat	neat	feat	seat	meat	beat
7	bean	beach	beat	beak	bead	beam
8	went	sent	bent	dent	tent	rent
9	pat	pad	pan	path	pack	pass
10	sag	sat	sass	sack	sad	sap
11	sum	sun	sung	sup	sub	sud
12	dug	dung	duck	dud	dub	dun
13	pen	hen	men	then	den	ten
14	took	cook	look	hook	shook	book
15	dip	sip	hip	tip	lip	rip
16	din	dill	dim	dig	dip	did
17	save	same	sale	sane	sake	safe
18	must	bust	gust	rust	dust	just
19	wick	sick	kick	lick	pick	tick
20	pig	big	dig	wig	rig	fig
21	cup	cut	cud	cuff	cuss	cub
22	shop	mop	cop	top	hop	pop
23	same	name	game	tame	came	fame
24	not	tot	got	pot	hot	lot
25	mass	math	map	mat	man	mad
26	puff	puck	pub	pus	pup	pun
27	pin	sin	tin	fin	din	win
28	fun	sun	bun	gun	run	nun
29	fill	kill	will	hill	till	bill
30	bun	bus	but	bug	buck	buff
31	bed	led	fed	red	wed	shed
32	sill	sick	sip	sing	sit	sin
33	cane	case	cape	cake	came	cave
34	kit	bit	fit	hit	wit	sit
35	hold	cold	told	fold	sold	gold
36	hard	dark	mark	bark	park	lark
37	fit	fib	fizz	fill	fig	fin
38	vest	test	rest	best	west	nest
39	bale	gale	sale	tale	pale	male
40	kill	kin	kit	kick	king	kid
41	way	may	say	pay	day	gay
42	back	bath	bad	bass	bat	ban
43	thaw	law	raw	paw	jaw	saw
44	peace	peas	peak	peach	peat	peal
45	ray	raze	rate	rave	rake	race
46	lane	lay	late	lake	lace	lame
47	pig	pill	pin	pip	pit	pick
48	seep	seen	seethe	seek	seem	seed
49	heave	hear	heat	heal	heap	heath
50	pale	pace	page	pane	pay	pave

LIST 6X

1	rate	rave	raze	ace	ray	rake
2	tap	tack	tang	tab	tan	tam
3	king	kit	kill	kin	kid	kick
4	feel	eel	reel	heel	peel	keel
5	rust	dust	just	must	bust	gust
6	oil	foil	toil	boil	soil	coil
7	pip	pit	pick	pig	pill	pin
8	wit	fit	kit	bit	sit	hit
9	bat	bad	back	bath	ban	bass
10	bang	rang	sang	gang	hang	fang
11	tent	bent	went	sent	rent	dent
12	seat	meat	beat	heat	neat	feat
13	pan	path	pad	pass	pat	pack
14	bead	beat	bean	beach	beam	beak
15	sad	sass	sag	sat	sap	sack
16	sung	sup	sun	sud	sum	sub
17	gun	run	nun	fun	sun	bun
18	heap	heat	heave	hear	health	heal
19	sake	sale	save	same	safe	sane
20	dud	dub	dun	dug	dung	duck
21	men	then	hen	ten	pen	den
22	tale	pale	male	bale	gale	sale
23	look	hook	cook	book	took	shook
24	rest	best	test	nest	vest	west
25	tip	lip	rip	dip	sip	hip
26	pus	pup	pun	puff	puck	pub
27	dim	dig	dill	did	din	dip
28	cop	top	mop	pop	shop	hop
29	game	tame	name	fame	same	came
30	lick	pick	tick	wick	sick	kick
31	sip	sing	sick	sin	sill	sit
32	raw	paw	law	saw	thaw	jaw
33	day	say	way	may	gay	pay
34	fig	pig	rig	dig	wig	big
35	din	tin	pin	sin	win	fin
36	cut	cub	cuff	cuss	cud	cup
37	hot	got	not	tot	lot	pot
38	buck	but	bun	bus	buff	bug
39	dark	lark	bark	park	mark	hark
40	hill	till	bill	fill	kill	will
41	seam	seethe	seep	seen	seed	seek
42	red	wed	shed	bed	led	fed
43	cave	cane	came	cape	cake	case
44	peat	peak	peace	peas	peal	peach
45	mat	man	mad	mass	math	map
46	teal	teach	team	tease	teak	tear
47	sold	told	hold	cold	gold	fold
48	pane	pay	pave	pale	pace	page
49	fin	fit	fig	fizz	fill	fib
50	lake	lace	lame	lane	lay	late

LIST 1Y

1	kick	lick	sick	tick	wick	pick
2	neat	beat	seat	meat	feat	heat
3	pun	puff	pup	pub	pus	puck
4	hook	shook	book	took	cook	look
5	lip	hip	dip	sip	rip	tip
6	rake	rate	ray	raze	race	rave
7	fang	bang	hang	sang	gang	rang
8	will	hill	kill	bill	fill	till
9	map	mat	math	mad	mass	man
10	pale	sale	bale	gale	male	tale
11	sane	sake	safe	save	same	sale
12	peak	peach	peas	peal	peace	peat
13	kin	kid	kick	king	kit	kill
14	sack	sad	sap	sag	sat	sass
15	sit	sip	sill	sick	sin	sing
16	fold	sold	gold	hold	cold	told
17	but	bug	bus	buff	bun	buck
18	late	lake	lay	lame	lane	lace
19	run	bun	fun	sun	nun	gun
20	dust	gust	must	bust	just	rust
21	path	pack	pass	pat	pad	pan
22	dip	dim	din	dill	did	dig
23	fit	hit	bit	sit	kit	wit
24	tin	fin	sin	win	pin	din
25	tear	teal	teak	team	tease	teach
26	dent	tent	rent	went	sent	bent
27	sup	sub	sud	sum	sun	sung
28	wed	fed	bed	led	shed	red
29	pot	hot	lot	not	tot	got
30	duck	dud	dung	dun	dug	dub
31	pit	pin	pig	pill	pick	pip
32	seethe	seek	seen	seed	seep	seem
33	say	pay	may	gay	way	day
34	best	west	nest	vest	test	rest
35	page	pane	pace	pave	pale	pay
36	bass	bat	ban	back	bath	bad
37	hop	cop	shop	mop	pop	top
38	dig	wig	big	fig	pig	rig
39	tack	tam	tab	tan	tang	tap
40	cake	came	cave	cane	case	cape
41	tame	came	fame	same	name	game
42	toil	boil	foil	coil	oil	soil
43	fig	fizz	fit	fib	fin	fill
44	cuss	cud	cup	cut	cub	cuff
45	heel	peel	keel	feel	eel	reel
46	mark	bark	dark	lark	hark	park
47	heath	heave	heap	heat	heal	hear
48	then	den	ten	pen	hen	men
49	law	saw	paw	jaw	raw	thaw
50	beat	beak	beach	beam	bean	bead

LIST 2Y

1	sent	rent	dent	tent	bent	went
2	told	fold	cold	gold	hold	sold
3	pass	pat	pack	pan	path	pad
4	lay	lame	lake	lace	late	lane
5	sit	kit	wit	fit	hit	bit
6	just	must	dust	gust	rust	bust
7	team	tease	teach	tear	teal	teak
8	dill	did	dig	dip	dim	din
9	shed	bed	wed	fed	red	led
10	win	pin	din	tin	fin	sin
11	dung	dun	dud	dub	duck	dug
12	sud	sum	sub	sung	sup	sun
13	seed	seep	seem	seethe	seek	seen
14	tot	lot	pot	not	got	not
15	nest	vest	west	rest	best	test
16	pick	pig	pit	pin	pip	pill
17	bath	ban	bass	bat	bad	back
18	gay	way	day	say	pay	may
19	rig	dig	pig	big	fig	wig
20	pace	pave	pane	pay	page	pale
21	cape	cake	case	cave	cane	came
22	mop	pop	top	hop	cop	shop
23	boil	soil	coil	oil	foil	toil
24	tab	tan	tam	tap	tack	tang
25	fill	fig	fin	fit	fib	fizz
26	fame	same	came	game	tame	name
27	reel	heel	eel	keel	feel	peel
28	bark	park	lark	hark	dark	mark
29	hear	heath	heal	heap	heat	heave
30	cud	cuff	cut	cub	cup	cuss
31	saw	thaw	jaw	raw	paw	law
32	den	men	pen	hen	ten	then
33	puck	pun	pus	pup	pub	puff
34	beak	bead	beam	bean	beach	beat
35	beat	heat	meat	feat	seat	neat
36	hip	tip	sip	rip	dip	lip
37	kid	kill	king	kit	kick	kin
38	rang	fang	gang	hang	sang	bang
39	shook	look	took	cook	book	hook
40	man	map	mass	math	mad	mat
41	rave	rake	race	ray	raze	rate
42	sale	sane	same	safe	save	sake
43	till	will	fill	kill	bill	hill
44	sick	sin	sing	sit	sip	sill
45	sale	tale	gale	male	bale	pale
46	sick	tick	lick	pick	kick	wick
47	peach	peat	peal	peace	peas	peak
48	buff	bun	buck	but	bug	bus
49	sass	sack	sat	sap	sag	sad
50	nun	fun	run	bun	gun	sun

LIST 3Y

1	cold	gold	fold	sold	told	hold
2	lace	late	lane	lay	lame	lake
3	gust	rust	bust	just	must	dust
4	dig	dip	did	din	dill	dim
5	fin	din	win	pin	sin	tin
6	sub	sung	sum	sun	sud	sup
7	got	pot	tot	lot	not	hot
8	pin	pip	pill	pick	pig	pit
9	pay	day	gay	way	may	say
10	pay	page	pale	pace	pave	pane
11	top	hop	pop	shop	mop	cop
12	tam	tap	tan	tang	tab	tack
13	eel	keel	heel	peel	reel	feel
14	heat	heal	hear	heath	heave	heap
15	jaw	raw	thaw	law	saw	paw
16	pup	pub	puff	puck	pun	pus
17	feat	seat	neat	beat	heat	meat
18	kick	king	kid	kill	kin	kit
19	book	took	shook	look	hook	cook
20	raze	race	rave	rake	rate	ray
21	kill	bill	hill	till	will	fill
22	sat	sap	sack	sad	sass	sag
23	male	bale	pale	sale	tale	gale
24	peal	peace	peat	peak	peach	peas
25	bent	dent	sent	rent	went	tent
26	bun	gun	sun	nun	fun	run
27	bug	buck	buff	bun	bus	but
28	pick	kick	wick	sick	tick	lick
29	sing	sit	sin	sill	sick	sip
30	came	game	same	name	fame	tame
31	sake	sale	save	same	safe	sane
32	math	mad	mat	man	map	mass
33	sang	gang	rang	fang	bang	hang
34	rip	dip	lip	hip	tip	sip
35	beam	bean	bead	beat	beak	beach
36	ten	pen	den	men	then	hen
37	cub	cup	cuss	cud	cuff	cut
38	lark	hark	park	mark	bark	dark
39	fib	fin	fill	fig	fizz	fit
40	foil	coil	boil	soil	toil	oil
41	case	cave	cake	came	cape	cane
42	big	fig	wig	rig	dig	pig
43	bed	bass	bath	ban	back	bat
44	west	rest	vest	test	nest	best
45	seek	seem	seed	seep	seen	seethe
46	dub	duck	dug	dung	dun	dud
47	fed	red	led	shed	bed	wed
48	teach	tear	tease	teak	team	teal
49	hit	wit	sit	kit	bit	fit
50	pack	pan	pat	pad	pass	path

LIST 4Y

1	bun	gun	sun	nun	fun	run
2	kick	king	kid	kill	kin	kit
3	gust	rust	bust	just	must	dust
4	pin	pip	pill	pick	pig	pit
5	bed	bass	bath	ban	back	bat
6	bent	dent	sent	rent	went	tent
7	pack	pan	pat	pad	pass	path
8	kill	bill	hill	till	will	fill
9	sang	gang	rang	fang	bang	hang
10	sub	sung	sum	sun	sud	sup
11	pay	page	pale	pace	pave	pane
12	sale	sake	save	same	safe	sane
13	tam	tap	tan	tang	tab	tack
14	male	bale	pale	sale	tale	gale
15	west	rest	vest	test	nest	best
16	pup	pub	puff	puck	pun	pus
17	top	hop	pop	shop	mop	cop
18	came	game	same	name	fame	tame
19	sing	sit	sin	sill	sick	sip
20	rip	dip	lip	hip	tip	sip
21	pay	day	gay	way	may	say
22	fin	din	win	pin	sin	tin
23	foil	coil	boil	soil	toil	oil
24	cub	cup	cuss	cud	cuff	cut
25	big	fig	wig	rig	dig	pig
26	sat	sap	sack	sad	sass	sag
27	pick	kick	wick	sick	tick	lick
28	got	pot	tot	lot	not	hot
29	lark	hark	park	mark	bark	dark
30	seek	seem	seed	seep	seen	seethe
31	dub	duck	dug	dung	dun	dud
32	beam	bean	bead	beat	beak	beach
33	dig	dip	did	din	dill	dim
34	fed	red	led	shed	bed	wed
35	peal	peace	peat	peak	peach	peas
36	teach	tear	tease	teak	team	teal
37	math	mad	mat	man	map	mass
38	case	cave	cake	came	cape	cane
39	eel	keel	heel	peel	reel	feel
40	cold	gold	fold	sold	told	hold
41	jaw	raw	thaw	law	saw	paw
42	raze	race	rave	rake	rate	ray
43	hit	wit	sit	kit	bit	fit
44	fib	fin	fill	fig	fizz	fit
45	lace	late	lane	lay	lame	lake
46	bug	buck	buff	bun	bus	but
47	book	took	shook	look	hook	cook
48	ten	pen	den	men	then	hen
49	feat	seat	neat	beat	heat	meat
50	heat	heal	hear	heath	heave	heap

APPENDIX D

EXPECTED ENVIRONMENTAL EFFECTS ON PERFORMANCE OF SPECIFIC TASKS: CANDIDATE TEST CONDITIONS

This appendix presents tables which indicate expected environmental effects on performance of the tasks contained in the Sample Task Checklists in Appendix A of HEDGE. Wh--e a task is to be performed under the environmental conditions noted in this appendix and the environmental effects noted are anticipated to produce problems, inclusion of the conditions in the test should be considered. Appendix D covers the twenty-one Test Function/Item Class/Subclass combinations listed in Figure 3 of HEDGE.

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Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Gain Access/Egress

Operator Subfunction: Climb Up/Down

Test Function: Operability
Test Item Class: Vehicles
Subclass: Maneuvering

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Man-Item Tasks	Cold Regions Environmental Effects									Cold Effects			Comments
	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	
Mount steps, ladders, ramps.					X							X1	1 - ice on steps, ladders
Use tires/hubs/structural members for mounting.					X		X					X1	2 - snow, ice covered
Use handholds/railings.				X			X						
Carry loads while ascending/descending.						X							
Raise load to step/platform.							X	X					
Read/observe warning/instruction labels.			X2										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Gain Access/Egress

Operator Subfunction: Open/Close

Test Function: Operability

Test Item Class: Vehicles

Subclass: Maneuvering

Checklist I A Page 2/7

Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Grasp door handle.				X			X						
Unlock/lock door latch.	X			X			X				X1		1 - latch freeze up
Unlatch/latch door.	X			X			X				X1		2 - door freeze up
Push/pull door open/closed.		X		X			X				X2		
Use handhold				X			X						

Columns "Reduced Dexterity" through "Reduced Hearing Capability": Cold Regions Environmental Effects. Columns "Decision Making" through "Hazards": Cold Effects.

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location Outside

Operator Function Prepare for Operation

Operator Subfunction Checkout

Test Function Operability

Test Item Class Vehicles

Subclass Maneuvering

Checklist I A **Page** 3/7

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Visually inspect external operating components.			X1										
Verify adjustments/structural/integrity/operational readiness.			X	X		X	X	X			X		1 - snow, ice covering
Follow published procedures where applicable.			X										
Input test signals to dispalys, read and interpret results.			X							X			
Determine control readiness.	X		X										
Set controls	X		X	X			X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: In or Out

Operator Function: Prepare for Operations

Operator Subfunction: Take/Leave Position

Test Function: Operability
Test Item Class: Vehicles
Subclass: Maneuvering

Checklist I A **Page** 4/7

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance*	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Step through eniry.						X	X						
Take or leave seat.						X							
Doff or don clothing items.						X							
Place clothing, tools, weapons, etc. into storage area.						X	X						
Adjust seats, windows, belts, and mirrors.	X			X			X						
Adjust seat belts and shoulder harness.	X						X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location In Cab - Out	**Test Function** Operability **Test Item Class** Vehicles **Subclass** Maneuvering
Operator Function Operate	**Checklist** I A **Page** 5/7
Operator Subfunction Start/Monitor/Stop	

Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
	Cold Regions Environmental Effects									Cold Effects			
Remove restraints (wheel chocks, dock lines, etc.).							X	X					1 - snow covering
Read labels.			X1										
Preset operating controls (choke, throttle, gearshift, etc.).	X			X			X						
Activate vehicle.	X			X	X		X						
Check displays.			X										
Manipulate controls.	X		X	X	X		X						
Communicate with crew members and/or passengers.									X				
Perform post-operational check (follow procedures if applicable).	X			X			X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: In Cab

Operator Function: Operate

Operator Subfunction: Control Direction/Speed

Test Function: Operability
Test Item Class: Vehicles
Subclass: Maneuvering

Checklist I A **Page** 6/7

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Material	Hazards
View external conditions by means of mirrors and windows.			X1 X2									
Check maps and charts.			X							X		
Identify destination and route.										X		
Operate steering control.	X	X					X					
Operate directional control.	X	X					X					
Operate speed control.					X		X					
Operate environment controls.	X			X			X					
Operate lighting controls.	X			X			X					
Operate visibility controls.	X			X			X					

Comments

1 - frosting of mirrors, windows

2 - ice fog from vehicle

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: In Cab

Operator Function: Operate (cont.)

Operator Subfunction: Control Direction/Speed (cont.)

Test Function Operability
Test Item Class Vehicles
Subclass Maneuvering

Checklist I A **Page** 7/7

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Avoid obstacles.	X	X											3 - effects of ear covering, vehicle noise, heater noise
Communicate with crew/other vehicles/command post.									X3				

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Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Gain Access/Egress

Operator Subfunction: Climb Up/Down

Test Function: Operability
Test Item Class: Vehicles
Subclass: Air

Checklist I B **Page** 1/5

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Mount steps/portable ladders.				X	X		X					X1	1 - icing of steps
Use structures for mounting.				X	X	X	X	X				X2	2 - structures brittle in cold
Use handholds/railings.				X			X						3 - snow, ice covering
Carry loads.		X											
Read labels/warnings.			X3										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: In Cockpit

Operator Function: Gain Access/Egress

Operator Subfunction: Take/Leave Position

Test Function: Operability
Test Item Class: Vehicles
Subclass: Air

Checklist: IB **Page** 2/5

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Open/close door/canopy.	X	X		X		X	X						
Prepare entry.							X						
Access seat area.						X							
Enter seat.						X							
Connect/disconnect G suits/cables/oxygen lines/restraints/etc.	X			X			X						
Adjust seats/restraints.	X						X						
Adjust visors.							X						
Remove/Install safety pins.	X						X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Test Function Operability
Test Item Class Vehicles
Subclass Air
Checklist I B Page 3/5

Location: In Cockpit
Operator Function: Perform Flight Operations
Operator Subfunction: Checkout/Fly

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Perform static check.	X						X						
Perform dynamic check.	X						X						
Taxi.			X	X	X								
Takeoff.			X	X	X								
Read displays.			X										
Cruise.			X	X	X								
Approach.			X	X	X								
Land.			X	X	X								

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location In Cockpit

Operator Function Perform Flight Operations

Operator Subfunction Intercept Target

Test Function Operability
Test Item Class Vehicles
Subclass Air

Checklist IB Page 4/5

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Detect target.			X							X			
Locate target.			X										
Track target.			X										
Monitor spatial relationships.			X										
Identify target.			X										
Perform intercept.			X										
Read weapon display.			X							X			
Select weapon.	X		X				X			X			

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: In Cockpit

Operator Function: Perform Flight Operations

Operator Subfunction: Perform In-Flight Missions

Test Function: Operability
Test Item Class: Vehicles
Subclass: Air

Checklist I B **Page** 5/5

Man-item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Remain on station.										X			1 - heater noise, ear coverings
Perform ELINT.	X		X							X			
Perform ECM/ECCM.	X		X							X			
Attack.			X	X	X								
Evaluate effects of attack.										X			
Communicate.									X1				

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Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Prepare for Use

Operator Subfunction: Load/Unload Materials

Test Function: Operability

Test Item Class: Vehicles

Subclass: Non-Maneuvering

Checklist IC Page 1/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Mate loading position with loading device.		X		X		X	X	X					1 - door freeze up
Open/close cargo doors.		X1		X		X	X	X					
Lower/raise platform/ramp.	X	X	X	X		X	X	X					
Mount steps/etc. with load.					X		X	X					
Pass load up to platform/ entryway.		X				X	X	X					
Transfer load to storage area.		X				X	X	X					
Secure load in/on item.	X	X		X		X	X	X					

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Prepare for Use

Operator Subfunction: Set Up for Use

Test Function: Operability
Test Item Class: Vehicles
Subclass: Non-Maneuvering

Checklist IC **Page** 2/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards
Transfer item to destination with prime mover.			X1									
Install permanent equipment.	X			X		X	X	X				
Block/lock wheels.							X	X				
Level item.		X						X				
Attach temporary steps/stairs.	X	X2	X	X			X	X				
Connect powerlines/cables/hoses.	X3	X	X4				X					
Deploy expendable units.		X					X				X5	

Comments

1 - ice fog from vehicle

2 - icing of receptacles

3 - icing of threads, connectors

4 - ice, snow covering of connector labels, color codes

5 - material shrinkage, siffening in cold

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Connect/Disconnect

Operator Subfunction: Engage Prime Mover

Test Function: Operability

Test Item Class: Vehicles

Subclass: Non-Maneuvering

Checklist 1C **Page** 3/6

Man-Item Tasks	Cold Regions Environmental Effects									Cold Effects			Comments
	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	
Connect lines/hoses from mover to item.	X	X1	X	X		X	X	X					1 - connector icing
Prepare hitch/connection.	X		X	X		X	X	X					2 - slips due to icy, uneven terrain
Align/mate prime mover and item.			X					X		X		X2	
Fasten/connect prime mover and item.	X	X	X				X	X					

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Connect/Disconnect

Operator Subfunction: Verify Operational Status

Test Function: Operability
Test Item Class: Vehicles
Subclass: Non-Maneuvering

Checklist IC **Page** 4/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Inspect hose/cable connections.			X1					X					1 - ice, snow covering
Manually/visually verify connection tightness.		X	X1					X					2 - effects of: - blowing snow - ice, fog - field of view reduced - hood - dark
Tighten/adjust connection.		X					X	X					
Inspect external operating components.			X2										
Read labels.			X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Utilize

Operator Subfunction: Gain Access/Egress

Test Function: Operability

Test Item Class: Vehicles

Subclass: Non-Maneuvering

Checklist IC **Page** 5/5

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Set up removable stairs/ladders.		X1		X			X	X					1 - icing of recceptacle
Climb steps/footholds.					X			X				X2	2 - icing of steps
Use handholds.				X			X						
Open/close doors/hatches.	X	X		X		X	X	X					
Pass through entryway.						X							

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Inside

Operator Function: Utilize

Operator Subfunction: Use as Workspace

Test Function: Operability

Test Item Class: Vehicles

Subclass: Non-Maneuvering

Checklist IC **Page** 6/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Inhabit test item.												X1	1 - fumes from heaters
Move about.						X							
Take position.						X							
Stow weapons/publications/ clothing.						X	X						
Communicate within/without workspace.									X				
Conduct operations						X							

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Prepare for Use

Operator Subfunction: Pre-Operational Activities

Test Function: Operability
Test Item Class: Weapons
Subclass: Individual

Checklist II A **Page** 1/5

Man-Item Tasks	Cold Regions Environmental Effects									Cold Effects			Comments
	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	
Store in/on vehicle.							X						1 - handling of solvents in cold
Unstow/unpack.	X						X						
Pick up/put down.		X					X						
Carry in hand.	X			X									
Carry on body.						X							
Field-strip.	X												
Clean parts.	X											X1	
Mate parts.	X												
Tighten connections.	X												
Adjust slings.	X												

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Prepare for Use

Operator Subfunction: Assemble/Emplace

Test Function: Operability

Test Item Class: Weapons

Subclass: Individual

Checklist II A **Page** 2/5

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Mate subassemblies.	X						X						1 - connector icing
Make connections.	X	X1					X						
Emplace.	X	X					X						
Position for firing.		X	X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Prepare for Use

Operator Subfunction: Load/Prepare

Test Function: Operability
Test Item Class: Weapons
Subclass: Individual

Checklist: II A **Page** 3/5

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Select ammunition.	X		X1										1 - ice, snow covering
Mate ammunition.	X	X											
Activate ammunition feed.	X												
Ready sights and aiming aids.	X												
Ready aiming and tracking aids.	X												
Ready visual aids.	X												

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Use Weapon

Operator Subfunction: Aim

Test Function: Operability
Test Item Class: Weapons
Subclass: Individual

Checklist II A Page 4/5

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Take firing position.						X							
Position weapon for aiming.						X							
Locate target.			X										
Aim.			X	X									
Communicate.									X				

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Use Weapon

Operator Subfunction: Fire/Cease Firing

Test Function: Operability

Test Item Class: Weapons

Subclass: Individual

Checklist II A Page 5/5

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Fire designated burst.	X												
Alter aiming.	X												
Continue to fire.	X												
Communicate.									X				
Monitor firing.			X										
Verify effectiveness.			X							X			
Safe weapon.	X												

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Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Prepare for Use

Operator Subfunction: Pre-Operational Activities

Test Function: Operability
Test Item Class: Weapons
Subclass: Crew Served

Checklist II B **Page** 1/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Unpack/unstow.	X						X						1 - handling of solvents in cold
Select modes of operation.	X						X						
Perform static checkout.	X						X						
Perform cleaning.	X											X	
Tighten connections.	X	X					X						
Verify readiness.	X		X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Prepare for Use

Operator Subfunction: Assemble/Emplace

Test Function: Operability
Test Item Class: Weapons
Subclass: Crew Served

Checklist II B Page 2/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Read instructions.			X										1 - effects of ear covering, wind noise
Mate subassemblies.	X	X	X					X					
Emplace weapon.	X	X	X			X	X	X					
Identify ammunition.			X										
Stabilize weapon.		X	X				X	X					
Communicate.									X1				

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Prepare for Use

Operator Subfunction: Load/Prepare

Test Function Operability
Test Item Class Weapons
Subclass Crew Served

Checklist II B **Page** 3/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Select ammunition.			X										
Ready ammunition.	X												
Ready weapon for loading.	X			X		X	X	X					
Load ammunition.	X			X		X	X	X					
Verify loading.	X		X										
Ready sighting/ranging devices.	X					X	X						
Ready aiming aids.	X					X	X						
Ready visual aids.	X					X	X						
Ready sensors.	X					X	X						
Ready weapon control system.	X					X	X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Prepare for Use (cont.)

Operator Subfunction: Load/Prepare (cont.)

Test Function: Operability

Test Item Class: Weapons

Subclass: Crew Served

Checklist II B Page 4/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Ready support system	X					X	X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location Out or In

Operator Function Use Weapon

Operator Subfunction Aim/Position for Firing

Test Function Operability
Test Item Class Weapons
Subclass Crew Served

Checklist II B **Page** 5/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Position weapon for aiming.		X				X							
Activate aiming aids.	X												
Find target.			X										
Lay on target.			X										
Communicate.									X				

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location

Operator Function: Use Weapon

Operator Subfunction: Fire/Cease Firing

Test Function: Operability
Test Item Class: Weapons
Subclass: Crew Served

Checklist II B Page 6/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Determine when to fire.										X			
Fire.	X												
Alter aiming.	X												
Continue to fire.	X												
Communicate.									X				
Monitor firing.			X										
Verify effectiveness.			X										
Safe weapon.	X												
Configure weapon for transportation.	X	X											

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Gain Access/Egress

Operator Subfunction: Clim Up/Down

Test Function: Operability

Test Item Class: Materiel Handlers

Subclass: Soldier-Operated

Checklist III A Page 1/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Mount steps, ladders, ramps, etc.					X			X					1 - slips, falls on icy, uneven terrain
Use handholds.				X			X						
Use footholds.					X			X					
Carry load.		X											
Lift/lower load to/from platform /ledge.		X					X	X				X1	
Read instructions/labels/ warnings.			X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Gain Access/Egress

Operator Subfunction: Open/Close

Test Function: Operability

Test Item Class: Materiel Handlers

Subclass: Soldier-Operated

Checklist III A Page 2/3

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Grasp door handle.				X			X						1 - door freeze up
Unlock/lock door latch.	X												
Unlatch/latch door.	X												
Push/pull door open/shut.		X1		X			X						
Use handholds.				X									

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Prepare for Operations

Operator Subfunction: Checkout

Test Function: Operability
Test Item Class: Materiel Handlers
Subclass: Soldier-Operated

Checklist III A Page 3/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Visually inspect external operating components.			X1										1 - effects of dark, fog, blowing snow
Verify adjustment, structural integrity, operational readiness.	X		X										2 - direct effects of cold indirect effects of fatigue induced by cold
Input test signals to displays.	X												
Read/interpret displays.			X							X2			
Determine control readiness.										X			
Set controls.	X												
Check load transport system.	X		X										
Check load lift system.	X		X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: In Cab

Operator Function: Prepare for Operations

Operator Subfunction: Take/Leave Position

Test Function Operability
Test Item Class Materiel Handlers
Subclass Soldier-Operated

Checklist III A **Page** 4/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Step into/out of work area.						X		X					
Take/leave seat.						X							
Move to/from operating position.						X							
Remove clothing items/ encumbrances.						X							
Stow clothing/encumbrances.						X							

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: In Cab

Operator Function: Handle Materiel

Operator Subfunction: Engage Load

Test Function: Operability
Test Item Class: Materiel Handlers
Subclass: Soldier-Operated

Checklist III A Page 5/6

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Activate item.	X												1 - fatigue effects on distance judgments
Position materiel handling device.	X						X						
Orient materiel handling device.	X		X				X						
Identify load.			X										
Move materiel handling device to load.	X		X				X			X1			
Control direction/speed of item.	X		X				X						
Acquire load.	X		X				X						
Verify acquisition.			X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: In Cab
Operator Function: Handle Materiel
Operator Subfunction: Lift/Move/Deposit Materiel

Test Function: Operability
Test Item Class: Materiel Handlers
Subclass: Soldier-Operated

Checklist III A Page 6/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Read labels/instructions.			X										
Operate controls.	X						X						
Read/interpret displays.			X										
Lift load.	X		X										
Transport load.	X		X										
Identify deposit area.			X										
Deposit load.	X		X										
Monitor external objects/ conditions.			X										
Communicate as required.									X				

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Assemble/Install

Operator Subfunction: Assemble/Disassemble

Test Function: Operability
Test Item Class: Materiel Handlers
Subclass: Soldier-Monitored

Checklist III B Page 1/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Unpackage items and components.	X												
Read instructions.			X										
Obtain tools.						X							
Identify parts.			X		X								
Assemble parts.	X				X								
Disassemble parts.	X				X								
Store parts.	X				X								

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Assemble/Install

Operator Subfunction: Attach/Remove

Test Function Operability
Test Item Class Materiel Handlers
Subclass Soldier-Monitored

Checklist III B **Page** 2/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Place/align item.	X												1 - fastener icing
Connect fasteners.	X	X1											
Attach lines/hoses/cables/wires/pipes/etc.	X			X			X	X					
Level as necessary.	X	X											
Configure for use.	X												

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or in

Operator Function: Prepare for Use

Operator Subfunction: Checkout

Test Function: Operability
Test Item Class: Materiel Handlers
Subclass: Soldier-Monitored

Checklist III B Page 3/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Visually inspect components.			X										
Read labels.			X										
Manually verify connections.	X												
Set controls.	X						X						
Remove/inspect components/ measurement devices/etc.	X		X				X						
Perform operational check.	X		X				X						
Verify readiness.	X		X				X						
Communicate.									X				

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location Out or In

Operator Function Prepare for Use

Operator Subfunction Align/Adjust

Test Function Operability
Test Item Class Materiel Handlers
Subclass Soldier-Monitored

Checklist III B **Page** 4/6

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Make gross calibrations/ adjustments manually.	X					X	X						
Use tools/controls for fine adjustments.	X	X	X			X	X						
Tighten connections.	X					X	X						
Realign components as required.	X					X	X						
Change control settings.	X					X	X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Start/Monitor/Stop

Operator Subfunction: Initiate/Terminate

Test Function Operability
Test Item Class Materiel Handlers
Subclass Soldier-Monitored

Checklist III B **Page** 5/6

	Cold Regions Environmental Effects										Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Take operating position.					X								
Detennine when to s.art										X			
Start/stop power.	X												
Operate power sctting control.	X												
Bagin loading/transferring operations.	X												
Operate controls for continued operation.	X						X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Start/Monitor/Stop

Operator Subfunction: Monitor

Test Function: Operability

Test Item Class: Materiel Handlers

Subclass: Soldier-Monitored

Checklist III B Page 6/6

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Observe operation.			X										
Observe status.			X										
Observe performance.			X										
Determine rate of flow.			X										
Obtain samples.							X						
Identify problems.										X			
Communicate.									X				

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: In or Out

Operator Function: Prepare for Use

Operator Subfunction: Unpack/Assemble

Test Function: Operability

Test Item Class: Electronics/Signals

Subclass: Sensors & Detectors

Checklist IVA Page 1/6

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Read special handling instructions.			X										
Identify sensor.			X										
Retrieve from storage.							X						
Unpackage.	X												
Handle sensor.	X												
Deploy parts.	X												
Assemble parts.	X												

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location In or Out

Operator Function Prepare for Use

Operator Subfunction Configure for Use

Test Function Operability
Test Item Class Electronics/Signals
Subclass Sensors & Detectors

Checklist IVA **Page** 2/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Select modes of operation.	X												
Prepare interfaces/connections.	X						X						
Select technical parameters.	X								X				
Connect lines/cables/etc.	X												
Perform static checkout.	X												

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: In or Out

Operator Function: Use

Operator Subfunction: Position for Use

Test Function Operability
Test Item Class Electronics/Signals
Subclass Sensors & Detectors

Checklist IV A **Page** 3/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
If stationary: emplace/position/ or orient.	X												
If moving: attach to locomotion device.	X												
Point or aim.	X						X						
Conceal/camouflage as required.	X												
Reorient as required.	X												

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location

Operator Function: Use

Operator Subfunction: Activate/Adjust/Deactivate

Test Function: Operability
Test Item Class: Electronics/Signals
Subclass: Sensors & Detectors

Checklist IV A Page 4/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Activate sensor.	X												
Verify activation.			X										
Follow safety procedures.										X			
Read instructions.			X										
Communicate.									X				
Perform dynamic checkout.	X		X				X						
Perform quick deactivation.	X		X				X						
Control location/position/operation/feadback of data.	X		X				X						
Control rate of motion/field of view.	X		X				X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location In or Out

Operator Function Monitor Information Feedback

Operator Subfunction Acquire/Interpret Information

Test Function Operability

Test Item Class Electronics/Signals

Subclass Sensors & Detectors

Checklist IVA **Page** 5/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Activate displays.	X												
Acquire/interpret sensed data.			X							X			
Verify validity of sensed data.										X			
Integrate data from different sensors.										X			
Assess data quality.										X			
Assess data quantity.										X			

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location in or Out

Operator Function Monitor Information Feedback

Operator Subfunction Determine Operational Status

Test Function Operability
Test Item Class Electronics/Signals
Subclass Sensors & Detectors

Checklist IV A **Page** 6/6

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Identify problems.										X			
Isolate problems.										X			

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Inside

Operator Function: Enter/Leave Station

Operator Subfunction: Enter Station

Test Function: Operability

Test Item Class: Electronics/Signals

Subclass: Information/Command-Control

Checklist IV B **Page** 1/6

Man-item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Grasp and operate door control.	X	X	X	X			X	X					1 - door freeze up
Push/pull/slide door open/closed.		X1					X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Inside

Operator Function: Enter/Leave Station

Operator Subfunction: Take Position at Station

Test Function: Operability
Test Item Class: Electronics/Signals
Subclass: Information/Command-Control

Checklist IV B **Page** 2/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Step into or out of work area.						X							
Take or leave seat.						X							
Move to or from standing operator position.						X							
Remove excess clothing (rain, NBC, cold regions, etc.).						X							
Stow clothing, tools, packs, and other encumbrances.						X	X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Inside

Operator Function: Prepare for Operation

Operator Subfunction: Configure Station

Test Function: Operability

Test Item Class: Electronics/Signals

Subclass: Information/Command-Control

Checklist IV B **Page** 3/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Adjust environment controls.	X						X						
Select modes of operation.	X						X						
Integrate with other operators.									X				
Establish command links.	X						X						
Make connections.	X						X						
Follow procedures.	X												
Communicate.									X				
Interact with support systems.									X				

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Inside

Operator Function: Prepare for Operation

Operator Subfunction: Perform Checkout

Test Function: Operability

Test Item Class: Electronics/Signals

Subclass: Information/Command-Control

Checklist IV B **Page** 4/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Check control settings.	X							X					
Check data return quality.			X							X			
Check data return format.			X										
Check links.	X		X										
Verify operational readiness.	X		X							X			

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Inside

Operator Function: Operate Station

Operator Subfunction: Acquire/Interpret Information

Test Function: Operability
Test Item Class: Electronics/Signals
Subclass: Information/Command-Control

Checklist IV B **Page** 5/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Obtain/monitor continuous data.	X	X					X			X			
Obtain/monitor discrete data.	X	X					X			X			
Obtain/monitor status data.	X	X					X			X			
Obtain verification data.	X	X					X			X			
Identify/isolate problems.										X			
Assess requirement to modify operations.										X			

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Inside

Operator Function: Operate Station

Operator Subfunction: Control/Adjust Operations

Test Function: Operability
Test Item Class: Electronics/Signals
Subclass: Information/Command-Control

Checklist IV B Page 6/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Activate system/change control settings.	X						X						
Change system configuration.	X						X						
Change software.	X						X						
Input discrete commands.	X						X						
Input continuous control.	X						X						
Monitor computer/communications/sensor systems			X						X				

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Prepare Item

Operator Subfunction: Unstow/Configure

Test Function: Operability
Test Item Class: Operational Support
Subclass: Maintenance & Repair

Checklist VA **Page** 1/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Identify parts.			X										
Unstow parts.	X												
Layout/deploy parts.	X						X						
Align/adjust parts.	X						X						
Make connections.	X						X						
Assemble parts.	X						X						
Mate subassemblies.	X						X						
Prepare rigs.	X						X						
Read instructions.			X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Prepare Item

Operator Subfunction: Emplace/Position at Worksite

Test Function: Operability

Test Item Class: Operational Support

Subclass: Maintenance & Repair

Checklist VA Page 2/6

Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Cold Effects: Equipment & Materiel	Cold Effects: Hazards	Comments
Move assembly.		X						X					
Position/orient components.		X						X					
Emplace at worksite.		X						X					
Locate components at worksite.	X							X					

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or in

Operator Function: Prepare Worksite

Operator Subfunction: Configure Workstation

Test Function: Operability

Test Item Class: Operational Support

Subclass: Maintenance

Checklist VA Page 3/6

Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
	Cold Regions Environmental Effects									Cold Effects			
Take position.						X							
Adjust seats.	X												
Set up station.						X							
Prepare materiel.	X					X	X						
Select operating modes.	X						X						
Perform checkout.	X		X				X						
Read instructions.			X										
Prepare support systems.	X		X				X						
Locate/prepare support personnel.									X				

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Perform

Operator Subfunction: Control/Adjust Operations

Test Function: Operability

Test Item Class: Operational Support

Subclass: Maintenance & Repair

Checklist VA Page 4/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Activate power.	X						X						
Change control settings.	X						X						
Perform test.	X						X						
Perform inspection.	X		X				X						
Perform removal/replacement.	X		X				X						
Perform repair.	X		X				X						
Perform site leveling.	X		X				X						
Perform construction.	X		X				X						
Perform resupply/ refurbishment.	X		X				X						
Perform materiel erection.	X		X				X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Perform (cont.)

Operator Subfunction: Control/Adjust Operations (cont.)

Test Function: Operability

Test Item Class: Operational Support

Subclass: Maintenance & Repair

Checklist VA Page 5/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Emplace/orient tools	X						X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Perform

Operator Subfunction: Monitor/Verify Operations

Test Function: Operability

Test Item Class: Operational Support

Subclass: Maintenance & Repair

Checklist VA Page 6/6

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Observe operations.			X										
Observe location of objects.			X										
Detect obstacles.			X										
Monitor performance.			X										
Monitor status.			X										
Verify operations.			X						X	X			

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Assemble/Set Up

Operator Subfunction: Assemble/Disassemble

Test Function: Operability

Test Item Class: Operational Support

Subclass: Materiel Prod & Environ Control

Checklist VB **Page** 1/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Unstow/stow components.	X							X					
Read/interpret instructions/ technical manuals.			X										
Identify parts.			X										
Connect components.	X		X				X						
Mate components to chassis.	X	X	X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location Out or In

Operator Function Assemble/Set Up

Operator Subfunction Emplace

Test Function Operability
Test Item Class Operational Support
Subclass Materiel Prod & Environ Control

Checklist VB **Page** 2/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Install subassemblies.		X	X			X		X					1 - connector icing
Make connections.	X	X	X			X	X	X					
Position for use.		X				X		X					

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location Out or In

Operator Function Prepare for Use

Operator Subfunction Align/Calibrate/Adjust

Test Function Operability
Test Item Class Operational Support
Subclass Materiel Prod & Environ Control

Checklist VB **Page** 3/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Interpret technical manuals/ labels.										X			1 - fastener icing
Tighten/loosen fasteners.	X	X1											
Set/adjust controls.	X		X				X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Prepare for Use

Operator Subfunction: Service

Test Function: Operability
Test Item Class: Operational Support
Subclass: Materiel Prod & Environ Control

Checklist VB **Page** 4/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Determine status of expendables.			X										
Open/close access covers.	X	X											
Remove/replace filler caps.	X	X											

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Use

Operator Subfunction: Activate/Deactivate

Test Function Operability
Test Item Class Operational Support
Subclass Materiel Prod & Environ Control

Checklist VB **Page** 5/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Start gasoline engines.	X						X						
Ignite pilot light/burner.	X			X			X						
Turn on electrical power.	X			X			X						
Initiate air/hydraulic power.	X			X			X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Use

Operator Subfunction: Perform Prime Function

Test Function: Operability

Test Item Class: Operational Support

Subclass: Materiel Prod & Environ Control

Checklist VB Page 6/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Operate equipment according to operating manuals.	X						X						
Manipulate controls.	X						X						
Observe/monitor displays.			X										
Perform manual/tool assisted operations.	X	X	X	X	X	X	X	X					
Observe/test status of materiels.			X				X						
Remove/inspect finished product.			X				X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Unpackage/Package

Operator Subfunction: Stow/Unstow

Test Function: Operability

Test Item Class: Troop Support Equipment

Subclass: Consumables

Checklist VI A **Page** 1/6

Man-Item Tasks	Cold Regions Environmental Effects									Cold Effects			Comments
	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	
Insert item into/remove item from carrying case.	X												
Place item in/remove item from pockets/shirt/pack.	X												
Strap/connect item to personal carrying gear	X												
Remove large item from storage area.		X											

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Unpackage/Package

Operator Subfunction: Open/Close Package

Test Function: Operability
Test Item Class: Troop Support Equipment
Subclass: Consumables

Checklist VI A Page 2/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Rip/tear plastic/foil/paper/ sacks, or envelopes.	X	X											
Open/pierce metal/plastic containers (not recloseable).		X											
Remove/replace caps/covers.	X	X											

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Prepare

Operator Subfunction: Premix

Test Function: Operability

Test Item Class: Troop Support Equipment

Subclass: Consumables

Checklist VIA Page 3/6

Man-Item Tasks	Cold Regions Environmental Effects									Cold Effects			Comments
	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	
Measure water/other liquids.			X										
Measure dry materiels.	X		X										
Add liquid/dry materiels in correct proportions.	X		X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Prepare

Operator Subfunction: Heat/Agitate

Test Function: Operability

Test Item Class: Troop Support Equipment

Subclass: Consumables

Checklist VIA **Page** 4/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Place item over fire/in hot water.							X						
Empty consumable into cooking/eating utensil.							X						
Stir materiel.	X												
Agitate package.	X												

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Use/Consume

Operator Subfunction: Apply/Remove

Test Function: Operability

Test Item Class: Troop Support Equipment

Subclass: Consumables

Checklist VI A Page 5/6

Man-Item Tasks	Cold Regions Environmental Effects									Cold Effects			Comments
	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	
Remove/replace cap/cover.	X												
Obtain/prepare applicator.	X												
Clean/prepare skin.	X												
Apply/remove salve/oil.	X												
Sprinkle/spread powder.	X												

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Use/Consume

Operator Subfunction: Ingest

Test Function: Operability

Test Item Class: Troop Support Equipment

Subclass: Consumables

Checklist VI A Page 6/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Eat/drink item.	X												
Utilize pouring/drinking spout.	X												
Dispose of wastes.	X												

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Perform Preventive Maint

Operator Subfunction: Perform Routine Servicing

Test Function: Maintainability
Test Item Class: Vehicles
Subclass: N/A

Checklist: M I Page 1/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Gain access to components.				X		X	X	X				X1	1 - use of solvents in cold
Assemble tools/support equipment.	X												
Clean components.	X												
Tighten components.	X	X											
Adjust components	X												
Align components.	X		X										
Calibrate components.	X		X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Perform Preventive Maint

Operator Subfunction: Inspect/Checkout

Test Function Maintainability
Test Item Class Vehicles
Subclass N/A

Checklist M i **Page** 2/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Retrieve checklists/inspection procedure.							X						
Conduct walk around inspection.			X					X					
Conduct static checkout.	X		X										
Conduct dynamic checkout.	X		X										
Check fittings.	X		X				X						
Check valves.	X		X				X						
Check fluid pumps.	X		X				X						
Check flow rates.	X		X				X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Perform Preventive Maint

Operator Subfunction: Replenish/Resupply

Test Function: Maintainability

Test Item Class: Vehicles

Subclass: N/A

Checklist: M I **Page** 3/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Remove/replace.	X												1 - handling POL items in cold
Attach lines/hoses.	X						X						
Refill.	X											X1	
Charge.	X												
Disconnect lines.	X						X						
Blow/clean lines.	X												
Remove covers.	X												

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Perform Corrective Maint

Operator Subfunction: Detect/Isolate Faults

Test Function: Maintainability
Test Item Class: Vehicles
Subclass: N/A

Checklist M I Page 4/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Identify failure.			X										
Identify affected system.			X										
Identify faulty component.			X							X			
Identify faulty part.			X							X			
Read displays.			X										
Use test sets.	X		X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Perform Corrective Maint

Operator Subfunction: Prepare for Repair

Test Function Maintainability
Test Item Class Vehicles
Subclass N/A

Checklist M I Page 5/6

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Configure system.	X		X			X	X						
Configure component.	X		X			X	X						
Configure part.	X		X			X	X						
Select tools.	X		X				X						
Configure support systems.	X		X				X						
Remove component.	X		X			X	X						
Disassemble component.	X		X			X	X						
Inspect parts.			X			X							

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location Outside or In

Operator Function Perform Corrective Maint

Operator Subfunction Repair

Test Function Maintainability
Test Item Class Vehicles
Subclass N/A

Checklist M I **Page** 6/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Perform electrical repair.	X		X	X		X	X	X					
Perform mechanical repair.	X		X	X		X	X	X					
Perform hydraulic repair.	X		X	X		X	X	X					
Remove/replace parts.	X		X	X		X	X	X					
Repair parts.	X		X	X		X	X	X					
Conduct tests.	X		X										
Verify readiness. (See "inspect/ Checkout")	X		X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Perform Preventive Maint

Operator Subfunction: Adjust/Align

Test Function: Maintainability
Test Item Class: Weapons
Subclass: N/A

Checklist: M II **Page** 1/6

Man-item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Identify requirements.										X			
Consult publications.			X										
Read labels.			X										
Assemble tools.	X												
Access test points.	X		X	X		X	X						
Gain access to parts.				X		X	X	X					
Align/adjust parts.	X		X				X						
Use controls/tools.	X		X				X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Perform Preventive Maint

Operator Subfunction: Service

Test Function: Maintainability
Test Item Class: Weapons
Subclass: N/A

Checklist M II Page 2/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards
Remove covers.	X	X										
Access service points/drains/ parts.	X		X	X		X	X	X				
Lubricate item.	X			X		X	X	X				X1
Fill with fluid.				X		X	X	X				
Read displays.			X									
Disassemble.	X		X				X					
Clean components.	X		X				X					X2
Tighten parts.	X	X					X					
Disconnect lines.	X	X					X					
Blow/clean lines.							X					

Comments

1 - handling of POL item in cold

2 - handling of solvents in cold

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Perform Preventive Maint

Operator Subfunction: Remove/Replace

Test Function: Maintainability

Test Item Class: Weapons

Subclass: N/A

Checklist: M II **Page** 3/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Handle expendables/replaceables.		X				X							
Prepare system for module removal.				X		X	X	X					
Prepare module for removal.				X		X	X	X					
Prepare workspace for module.				X		X	X	X					
Stow module.						X	X	X					
Install fresh module.		X	X	X		X	X	X					

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Perform Corrective Maint

Operator Subfunction: Troubleshoot

Test Function: Maintainability
Test Item Class: Weapons
Subclass: N/A

Checklist M II Page 4/6

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Detect faults.			X										
Access test points.	X		X	X		X	X	X					
Acquire measures/data.	X		X										
Interpret data.										X			
Consult publications.			X										
Isolate fault to component.										X			

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Perform Corrective Maint

Operator Subfunction: Repair

Test Function Maintainability
Test Item Class Weapons
Subclass N/A

Checklist M II Page 5/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Assemble tools.	X												
Arrange lines/cables.	X		X				X						
Configure system.			X	X		X	X	X					
Configure support equipment.			X	X		X	X	X					
Conduct structural repair.			X	X		X	X	X					
Conduct mechanical repair.			X	X		X	X	X					
Conduct electrical repair.			X	X		X	X	X					
Disassemble component.	X						X						
Inspect parts.			X			X		X					
Replace parts.			X			X		X					

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside or In

Operator Function: Perform Corrective Maint

Operator Subfunction: Test & Calibration

Test Function: Maintainability

Test Item Class: Weapons

Subclass: N/A

Checklist M ll Page 6/6

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Set up test stand.	X												
Obtain data.	X		X										
Interpret data.										X			
Consult publications.			X										
Consult calibration tables.			X										
Validate repair.										X			

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside or In

Operator Function: Perform Preventive Maint

Operator Subfunction: Perform Routine Servicing

Test Function: Maintainability
Test Item Class: Materiel Handlers
Subclass: N/A

Checklist M III Page 1/6

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Clean components.	X						X					X1	1 - handling of solvents in cold
Tighten components.	X	X					X						
Adjust components.	X						X						
Align components.	X		X				X						
Calibrate components.	X		X				X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Perform Preventive Maint

Operator Subfunction: Inspect/Checkout

Test Function: Maintainability
Test Item Class: Materiel Handlers
Subclass: N/A

Checklist: M III **Page** 2/6

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Conduct walk around inspection.			X			X		X					
Conduct static checkout.	X		X				X						
Conduct dynamic checkout.	X		X				X						
Verify readiness.			X							X			

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Perform Preventive Maint

Operator Subfunction: Replenish/Resupply

Test Function: Maintainability
Test Item Class: Materiel Handlers
Subclass: N/A

Checklist M III Page 3/6

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Remove/replace.	X		X				X						
Attach lines/hoses.	X		X				X	X					
Refill.	X						X						
Charge.	X						X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Perform Corrective Maint

Operator Subfunction: Detect/Isolate Faults

Test Function: Maintainability
Test Item Class: Materiel Handlers
Subclass: N/A

Checklist M III Page 4/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Identify failure.			X							X			
Identify affected system			X							X			
Identify component.			X							X			
Identify faulty part.			X							X			

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Perform Corrective Maint

Operator Subfunction: Prepare for Repair

Test Function: Maintainability
Test Item Class: Materiel Handlers
Subclass: N/A

Checklist M III Page 5/6

Man-Item Tasks	Cold Regions Environmental Effects									Cold Effects			Comments
	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	
Configure system.	X		X	X		X	X	X					
Configure component.	X		X	X		X	X	X					
Configure part.	X		X	X		X	X	X					
Select tools.	X		X										
Configure support systems.	X		X	X		X	X	X					

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Out or In

Operator Function: Perform Corrective Maint

Operator Subfunction: Repair

Test Function: Maintainability

Test Item Class: Materiel Handlers

Subclass: N/A

Checklist M III Page 6/6

Man-Item Tasks	Cold Regions Environmental Effects									Cold Effects			Comments
	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	
Perform electrical repair.	X		X	X		X	X	X					1 - handling hydraulic fluid in cold
Perform mechanical repair.	X		X	X		X	X	X					
Perform hydraulic repair.	X		X	X		X	X	X				X1	
Verify repair. (See "Inspect/ Checkout")				X						X			

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: In or Out

Operator Function: Perform Preventive Maint

Operator Subfunction: Service

Test Function: Maintainability

Test Item Class: Electronics/Signals

Subclass: N/A

Checklist M IV Page 1/5

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Access components.	X		X	X			X						
Tighten components.	X	X		X			X						
Clean components.	X		X	X			X						
Align components.	X		X	X			X						
Adjust components.	X		X	X			X						
Calibrate components.	X		X	X			X						
Remove components.	X		X	X			X						
Replace components.	X		X	X			X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: In or Out

Operator Function: Perform Preventive Maint

Operator Subfunction: Inspect/Checkout

Test Function: Maintainability

Test Item Class: Electronics/Signals

Subclass: N/A

Checklist: M IV Page 2/5

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Acquire checklist.							X						
Access components.	X		X	X			X						
Adjust controls.	X		X	X			X						
Read displays.			X										
Read labels.			X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location In or Out

Operator Function Perform Corrective Maint

Operator Subfunction Troubleshoot

Test Function Maintainability

Test Item Class Electronics/Signals

Subclass N/A

Checklist M IV **Page** 3/5

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Activate controls.	X		X				X						
Acquire performance aids.	X		X				X						
Read displays.			X										
Access test points.	X		X	X			X						
Activate test equipment.	X												
Read signals.			X										
Make decisions.										X			

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: In or Out

Operator Function: Perform Corrective Maint

Operator Subfunction: Repair/Replace

Test Function: Maintainability

Test Item Class: Electronics/Signals

Subclass: N/A

Checklist M IV **Page** 4/5

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Break connections.	X	X1											1 - connector icing
Remove component.	X	X		X									
Repair component.	X		X	X		X	X						
Align component	X		X	X		X	X						
Replace component.	X	X	X	X		X	X						
Make connection.	X	X1											
Verify connection.			X										
Remove/replace module.	X		X	X		X	X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: In or Out

Operator Function: Perform Corrective Maint

Operator Subfunction: Test/Calibrate

Test Function: Maintainability

Test Item Class: Electronics/Signals

Subclass: N/A

Checklist: M IV **Page** 5/5

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Acquire job performance.							X						
Prepare test equipment.	X		X										
Mate component with test equipment.	X		X										
Control inputs.	X		X				X						
Read outputs.			X										
Check calibration charts.			X							X			
Verify repair. (See "Inspect/ Checkout")			X							X			

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Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: In or Out

Operator Function: Perform Preventive Maint

Operator Subfunction: Inspect/Checkout

Test Function: Maintainability

Test Item Class: Operational Support

Subclass: N/A

Checklist: MV **Page** 1/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Inspect structural components.			X										
Check tightness of fasteners/ connectors.	X	X											
Determine status of expendable materiels.			X										
Determine condition/expected life of line replaceable parts.			X										
Verify operational status of displays.			X							X			

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: In or Out

Operator Funcilon: Perform Preventive Maint

Operator Subfunction: Perform Routine P M

Test Function: Maintainability

Test Item Class: Operational Support

Subclass: N/A

Checklist: MV **Page** 2/6

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Clean/paint.	X		X									X1	1 - handling of solvents in cold
Add preservatives.	X		X										2 - handling of POL items in cold
Remove/replace minor items (lightbulbs/filters).	X		X										3 - connector freeze up
Lubricate.	X		X									X2	
Add expendables.	X		X										
Tighten fasteners/connectors.	X	X3											
Adjust/calibrate/align components.	X		X				X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: In or Out

Operator Function: Perform Non-Scheduled Maint

Operator Subfunction: Detect Malfunction

Test Function: Maintainability

Test Item Class: Operational Support

Subclass: N/A

Checklist: MV **Page** 3/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Monitor displays.			X										
Utilize visual/auditory cues.			X						X				
Detect changes in system operation.			X						X				
Read malfunctioning indicator.			X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: In or Out

Operator Function: Perform Non-Scheduled Maint

Operator Subfunction: Isolate/Identify/Causes

Test Function: Maintainability

Test Item Class: Operational Support

Subclass: N/A

Checklist: MV **Page** 4/6

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Material	Hazards	Comments
Visually inspect components.			X										
Read built-in test meters.			X										
Apply troubleshooting strategy.			X							X			
Apply auxiliary test equipment to test points.	X		X				X						
Obtain readouts.			X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: In or Out

Operator Function: Remove/Replace

Operator Subfunction: Remove Malfunctioning Comp

Test Function Maintainability
Test Item Class Operational Support
Subclass N/A

Checklist MV Page 5/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Open/secure accesses.	X						X						1 - icing of components
Remove fasteners/connectors.	X		X				X						
Lift/pull/slide/push components off of/out of item.	X	X1											

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: In or Out

Operator Function: Remove/Replace

Operator Subfunction: Replacement/Repair on Item

Test Function: Maintainability
Test Item Class: Operational Support
Subclass: N/A

Checklist MV **Page** 6/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards
Place/hold component in position.	X											
Apply/tighten fasteners/ connectors.	X	X1		X			X	X				
Attach cables/hoses/wires.	X		X	X			X	X				
Verify adequacy of replacement. (See "Inspect/Checkout")			X									
Repair component while mounted on item.	X		X	X	X	X	X	X				X2
Recalibrate/realign.	X		X									

Comments

1 - connector icing

2 - protrusions not readily seen in dark, reduced visibility conditions

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Prepare for Transport

Operator Subfunction: Place in Transit Configuration

Test Function: Transportability
Test Item Class: N/A
Subclass: N/A

Checklist T **Page** 1/5

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Position/lock movable components.	X	X1		X			X	X					1 - icing of parts
Remove/secure loose/projecting components.	X	X1		X			X	X					2 - material stiffening in cold
Apply protective covering.		X				X	X	X			X2		
Remove expendable liquids.	X							X					
Connect/remove auxiliary equipment (fording/winterizing kits).	X	X				X	X	X					

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Prepara for Transport

Operator Subfunction: Package

Test Function Transportability

Test Item Class N/A

Subclass N/A

Checklist T Page 2/5

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Disassemble item elements.	X												
Obtain/construct package.	X												
Insert item into package.	X	X											
Insert shock proofing materiel.	X			X									
Anchor item.	X	X											
Close package.	X												
Apply labeling.	X												

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Load/Unload

Operator Subfunction: Load onto Carrier

Test Function: Transportability

Test Item Class: N/A

Subclass: N/A

Checklist: T   Page 3/5

Man-item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Attach/remove hooks/cables to lifting points on item/package.	X		X	X		X	X	X					
Engage item with materiel handling components (forks).	X		X	X		X	X	X					
Place item on/in pallets/cargo nets/slings/other lifting and loading devices.	X	X	X	X		X	X	X					
Attach item where required lifting/sliding/rolling item to do so.	X	X	X	X		X	X	X					

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Secure/Unfasten

Operator Subfunction: Immobilize Item

Test Function: Transportability

Test Item Class: N/A

Subclass: N/A

Checklist: T **Page:** 4/5

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Secure ties to item.	X						X	X					
Secure ties to carrier.	X						X	X					
Increase/decrease tension of ties during/after initial task.	X	X		X			X	X					
Check out tie-downs during transit to verify connection/ tension.	X		X				X	X					
Check wheels/lock tracks.	X		X					X					

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Secure/Unfasten

Operator Subfunction: Prepare for Use

Test Function: Transportability
Test Item Class: N/A
Subclass: N/A

Checklist T **Page** 5/5

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Open package.	X												1 - handling of POL, solvents in cold
Remove item or components.	X												
Assemble item.	X		X										
Clean/lubricate/etc.	X											X1	
Install/set up/distribute item.	X		X										

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Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Carry/Wear Item

Operator Subfunction: Don/Doff

Test Function: Portability/Usability
Test Item Class: N/A
Subclass: N/A

Checklist P/U **Page** 1/6

Man-item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Put on/take off shirt/gloves/boots/trousers/protective clothing.						X					X1		1 - materials stiffen in cold
Button/snap/tie clothing.	X												
Attach/emplace load into/onto pack/load carrier/carrying case.	X	X											
Buckle straps/snap catches/otherwise attach portable gear to body/cartridge belt/pack harness.	X		X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Carry/Wear Item

Operator Subfunction: Wear

Test Function: Portability/Usability

Test Item Class: N/A

Subclass: N/A

Checklist P/U Page 2/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Wear clothing.											X1		1 - materials stiffen in cold
Wear personal equipment items (backpack/cartridge belt/etc.).											X1		

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Carry/Wear Item

Operator Subfunction: Carry Item

Test Function: Portability

Test Item Class: N/A

Subclass: N/A

Checklist P/U Page 3/5

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Carry item on back/body (no hands).		X											
Adjust carrying elements (straps /holders).	X												
Carry item in one/both hands.		X											
Carry item by one or more soldiers.		X											

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Carry/Wear Item

Operator Subfunction: Perform Combat Functions

Test Function: Portability/Usability

Test Item Class: N/A

Subclass: N/A

Checklist P/U Page 4/6

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Fasten item securely to body to prevent flapping/interference.	X												
Discard item in emergency (snagged on vegetation/barbed wire).	X												
Disconnect/raise item for wading if wetting is a problem.	X	X											
Carry item while performing various combat tasks.	X												
Eliminate noise sources caused by or relative to the item.	X								X				
Cover or modify visible/ reflecting surfaces to insure camouflage.	X		X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Utilize Item

Operator Subfunction: Prepare for Use

Test Function: Portability/Usability

Test Item Class: N/A

Subclass: N/A

Checklist P/U Page 5/6

	Cold Regions Environmental Effects									Cold Effects			
Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Decision Making	Equipment & Materiel	Hazards	Comments
Open access flaps/covers.	X												
Remove item from case.	X	X					X						
Connect components.	X						X						
Extend/fasten collapsible/folding components.	X						X						
Manipulate adjustment controls.	X						X						
Verify operational status.			X										
Clean/adjust optics.	X		X				X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Utilize Item

Operator Subfunction: Use

Test Function: Portability/Usability

Test Item Class: N/A

Subclass: N/A

Checklist P/U Page 6/6

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Material	Hazards	Comments
Put on/adjust item (goggles/life preserver).	X										X1		1 - materials stiffen in cold
Use item as designed (dig/ illuminate).	X												

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Prepare

Operator Subfunction: Layout/Inspect

Test Function: Erectability

Test Item Class: N/A

Subclass: N/A

Checklist E Page 1/4

Man-item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Unpackage/uncover components.	X												
Move components into proper relationship to each other according to S.O.P./technical instructions.	X		X	X		X	X	X					
Check out structural integrity of components as well as status of moving/sliding parts.	X		X	X		X	X	X					

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Assemble

Operator Subfunction: Perform Subassembly

Test Function: Erectability
Test Item Class: N/A
Subclass: N/A

Checklist E Page 2/4

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Prepare connecting points (clean, abrade/apply adhesive/etc.).	X												
Joint structural elements.	X	X	X	X			X	X					
Insert/tighten fasteners/ connectors.	X	X	X	X			X	X					
Align structural elements.	X	X	X				X	X					

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Assemble

Operator Subfunction: Perform Major Assembly

Test Function: Erectability

Test Item Class: N/A

Subclass: N/A

Checklist E Page 3/4

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Raise/move subassembly to connection point.		X				X		X					
Climb/stand on parts of item/ ladders/scaffolding/watercraft.				X	X	X	X	X					
Manipulate subassembly into proper position.		X				X		X					
Mate/fasten components.	X	X											
Insert gaskets.	X		X										
Connect cables/hoses/guywires/ other elements as required.			X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Verify Construction

Operator Subfunction: Final Inspection

Test Function: Erectability

Test Item Class: N/A

Subclass: N/A

Checklist E Page 4/4

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Conduct "engineering" type test (strain/leakage/bearing strength).	X		X	X		X	X	X	X	X			
Drive/place maximum load on item.		X											
Visually inspect subassembly placement/connection.			X										
Manually determine status of fasteners/connectors.	X	X	X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Outside

Operator Function: Translate/Transport

Operator Subfunction: Move About

Test Function: Habitability

Test Item Class: N/A

Subclass: N/A

Checklist: H **Page** 1/5

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Move through hallways.						X							
Climb ladders.				X	X	X	X						
Move through doors/hatches.						X							
Identify location.			X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Inside
Operator Function: Translate/Transport
Operator Subfunction: Transport Material

Test Function Habitability
Test Item Class N/A
Subclass N/A
Checklist H Page 2/5

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Carry loads.		X				X							
Move loads using transport aid.		X				X							
Move loads to/from storage.		X				X							
Secure/unsecure loads.	X					X	X						
Monitor loads during transport.			X										
Read labels/warnings.			X										
Avoid obstacles.			X										

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Inside

Operator Function: Perform On-Duty Activities

Operator Subfunction: Work

Test Function: Habitability
Test Item Class: N/A
Subclass: N/A

Checklist H Page 3/5

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Take position.						X							
Stow/unstow equipment.	X						X						
Inspect station.			X										
Communicate.									X				
Move about the building.						X							
Occupy workspace.						X							
Control workspace environment.	X						X						

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Inside

Operator Function: Perform Off-Duty Activities

Operator Subfunction: Perform Rest and Relaxation

Test Function: Habitability
Test Item Class: N/A
Subclass: N/A

Checklist H Page 4/5

Man-Item Tasks	Cold Regions Environmental Effects: Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Equipment & Materiel	Hazards	Comments
Prepare area.	X					X	X						
Stow/unstow equipment.	X	X				X	X						
Control environment.	X						X						
Sleep/rest.						X							
Perform solitary activity.						X							
Perform group activity.						X							

Expected Environmental Effects on Performance of Specific Tasks: Candidate Test Conditions

Location: Inside

Operator Function: Perform Off-Duty Activities

Operator Subfunction: Perform Living Activities

Test Function Habitability
Test Item Class N/A
Subclass N/A

Checklist H Page 5/5

Man-Item Tasks	Reduced Dexterity	Reduced Strength	Reduced Visibility	Reduced Hand Clearance	Reduced Foot Clearance	Reduced Whole Body Clearance	Reduced Reach Envelope	Reduced Mobility	Reduced Hearing Capability	Cold Effects: Decision Making	Cold Effects: Equipment & Materiel	Cold Effects: Hazards	Comments
Stow/unstow items.	X		X				X						
Perform self care.						X							
Perform medical care.						X							
Perform dental care.						X							
Perform eating.						X							
Perform waste elimination.						X							
Modify area decor.						X							

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APPENDIX E-1

GENERAL GLOSSARY

AI - Articulation Index.

Ambient lighting - Lighting throughout an area that produces general illumination.

Ambient noise - All-encompassing noise associated with a given environment, being usually a composite of sounds from many sources and with no particular sound being dominant.

Angle of Incidence - The angle between the line of direction of anything (as a ray of light or line of sight) striking a surface and a line perpendicular to that surface drawn to the point of contact.

ANSI - American National Standards Institute.

Anthropometry - Technology of measuring human physical traits; primarily size, mobility, and strength.

Audiometer - An instrument to measure sound pressure levels produced by the movement of molecules in the air caused by a sound.

A-weighting - Equipping a sound level meter with filters that screen sounds so that the meter's sensitivity to sounds of different frequencies resembles that of the ear. A-weighted readings are measured in decibels and are indicated by using the abbreviation dB(A).

Cathode Ray Tube (CRT) - An electronic tube in which a well-defined and controllable beam of electrons is produced and directed to a surface to give a visible or otherwise detectable display or effect. The face of a CRT is used in some interactive graphic display devices as the display surface.

CEOI - Communication and Electronic Operation Instruction.

Contrast - The difference in light intensity between what is being viewed and its background.

Cursor - A symbol or sign which acts as a flag to identify one and only one of the character spaces on the display screen of a VDT that will be affected by a command or action.

dB(A) - The unit used to express sound level measured through the A-weighting network of a sound level meter. See A-weighting.

dB(C) - The unit used to express sound level measured through the C-weighting network of a sound level meter.

Detent - A device (e.g., a catch or notch) for positioning and holding one mechanical part in relation to another so that the device can be released by force applied to one of the parts.

Direct glare - Glare resulting from high luminances or insufficiently shielded light sources in the field of view.

Discrimination - The process of detecting differences among signals to the sense organs.

Display - A pattern of sensory cues, usually visual or auditory, presented by means of instruments and arranged to provide information concerning the functioning of a machine or apparatus.

Display surface - The medium upon which a display image is produced (e.g., CRT screen, film, paper).

Egress - Path or opening by means of which one goes out.

Feedback - The knowledge of results received about the status or adequacy of outputs.

Flicker - A blinking or pulsation of a display image on a CRT display occurring when the refresh rate is so low that the regeneration does not keep the image at a constant intensity.

Font - The characteristics or style of a lettering or typeface.

Footcandle (fc) - A unit used to measure the intensity of ambient light (illuminance).

Footlambert (fL) - A unit used to measure intensity of reflected or emitted light (luminance).

Function key - A button or switch whose activation is interpreted as a command directive as opposed to a data item. Function keys are often included to execute a combination of machine functions without the need to perform each function separately.

Glare - A visual condition caused by excessive luminance variations within the field of vision (e.g., when bright sources of light such as windows or lamps or their reflected images fall in the line of sight).

Hard copy - The computer output in either printed or graphical form that can be read directly by humans and handled and filed.

Hertz (Hz) - Measurement of frequency; 1 hertz is an oscillation of one cycle per second.

HFE - Human Factors Engineering.

Human Factors Engineering (HFE) - The systematic application of information about human factors to the design of products, equipment, facilities, systems, and environments.

Human Factors Engineering Specialist - A person working in the human factors engineering area.

Hz - Hertz (cycles/second).

IAP - Independent Assessment Plan

IEP - Independent Evaluation Plan.

Illuminance - A measure of the quantity (density) of light reaching an object or surface. Measured in footcandles.

Illumination - The act of illuminating or state of being illuminated. The terms illumination and illuminance are used to connote density of luminous flux on a surface.

Ingress - A means or place of entering.

Ischial Tuberosities - The rounded portion of the bone on which the body rests when sitting.

Light-Emitting Diode (LED) - A semiconductor device which emits visible light when excited with an input voltage above the device's threshold voltage.

Lighting balance - The evenness of illumination across a group of displays.

Lighting uniformity - The evenness of illumination within a single display.

Luminance - The amount of light per unit area reflected from or emitted by a surface. Measured in footcandles. Formerly used synonyrn: photometric brightness.

Luminance contrast - The contrast between the background and a figure equals the absolute difference between the higher luminance (L1) and the lower luminance (L2) divided by the lower luminance.

Luminous flux - The amount of light emitted by a point source into 1 steradian (the unit of solid angle in space, as a radian is a unit of angle in a flat plane). Measured in lumens.

Lux (lx) - The standard international unit of illuminance. One lux is one lumen per square meter (lm/m2).

Masking - The partial or complete obscuring of one tone by another. The degree of masking is expressed in decibels.

Matte surface (finish) - One from which the reflection is predominantly diffuse, with or without a negligible specular component.

MRT - Modified Rhyme Test.

NC - Noise Criteria.

Octave - An interval in which the upper frequency is twice the lower frequency.

PB - Phonetically Balanced.

Peak clipping (of speech signals) - A technique for controlling amplitude relationships in speech by limiting the instantaneous peak-amplitudes to improve intelligibility of speech.

Phosphor - A coating of luminescent mate-rial which emits visible light when struck by a beam of electrons within an evacuated glass tube such as a CRT.

Photometer - An instrument for measuring photometric quantities such as luminance, luminous intensity, luminous flux, and illuminance.

Population stereotype - The way in which members of a population expect things to behave, especially with respect to directional movements.

Reflectance - The ratio between the quantity of light that is reflected from a given surface and the total quantity of light that is incident on the same surface.

Reflected glare - A glare condition caused by the reflection of bright sources of light, e.g., windows, luminaires, etc., from illuminated surfaces within the field of vision.

Refresh - A technique used to regularly energize the phosphor coating in the CRT to ensure an apparently continuous and stable but in fact transient image.

Refresh rate - The frequency with which the image on the face of a refreshed CRT is refreshed.

SIL - Speech Interference Level.

Speech intelligibility - A measure of the percentage of words, phrases, or sentences correctly understood over a given speech communication system in a given noise situation.

Speech Interference Level (SIL) - A measure of the effectiveness of noise in masking speech. It is the arithmentic mean, in dB, of sound pressure levels in the four octave bands with center frequencies of 500, 1000, 2000, and 4000 Hz.

Speech-to-noise ratio (peak speech to rms noise) - The ratio between the arithmetic mean of peak amplitudes of speech and the root-mean-square (rms) amplitude of back-ground noise.

SPL - Sound Pressure Level.

SRP - Seat Reference Point.

SRT - Speech Reception Threshold.

Task analysis - An analytical process for determining the specific behaviors required of the human components in a human-machine system. It involves determining the detailed performance required of people and equipment, and the effects of environmental conditions, malfunctions, and other unexpected events on both. Within each task to be performed by people, behavioral steps are analyzed in terms of (1) the sensory signals and related perceptions, (2) the decisions, memory storage, and other mental processes, and (3) the required responses.

TDP - Test Design Plan.

TLV - Threshold Limit Value.

Transillumination - Light passed through, rather than reflected off, an element to be viewed, e.g., illumination used on console panels or indicators utilizing edge and/or back lighting techniques on clear, translucent, fluorescent, or sandwich-type plastic materials.

Trim range - The range of display illumination from minimum to maximum brightness.

TWA - Time Weighted Average.

Viewing angle - The angle subtended by objects that can be seen during a single glance.

Visual angle - The angle subtended by an object or detail located some distance from the eye. It usually is measured in minutes of arc.

$$\text{Visual angle (arc min.)} = \frac{57.3 \text{ (deg./rad.)} \times 60 \text{ (min./deg.)} \times S}{D}$$

where: S = the size of the object measured perpendicular to the line of sight
D = the distance of the object from the eye.

The numbers in the formula are constants used when the angle is less than 600 minutes of visual arc.

Visual Display Terminal (VDT) - A terminal which comprises a keyboard for data input and a display screen for control of the input.

WI - Windchill Index is a measure of the cooling effect produced by a combination of ambient temperature and wind speed.

Window - The translucent, back-lighted, and usually labeled portion of a lighted visual display.

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APPENDIX E-2

USER-COMPUTER INTERFACE GLOSSARY

Alphanumeric - Pertaining to a character set that contains both letters and numerals.

Analog - Similar or comparable.

Baud - A measure of the transmission speed capability of a communications line or system. In a sequence of binary signals, 1 Baud = 1 Bit/sec.

Brevity - Information presented to the operator or entered by the operator is grouped into short, readily understandable units.

Buffer - An area of computer memory for temporary storage of an input or output record.

Cathode Ray Terminal (CRT) - A terminal which has a keyboard for data input and a display screen. Also used to describe a type of terminal in which an electronic vacuum tube energizes phosphors on a screen.

Character - The actual or coded representation of a digit, letter, or special symbol but not a space.

Code - A system of symbols and rules for use in representing information.

Command - A pulse, signal, or set of signals that occur in a computer as the result of an instruction and which initiate one step in the process of executing the instruction.

Compatibility - A system is compatible to the extent that workspace, input and output devices, and software accommodate user needs.

Consistency - A system is consistent to the extent that the behavior of the machine and documentation correspond to the expectations of the operator.

Control Action - An action taken by the user to alter the state of the system.

CRT - See **Cathode Ray Terminal**.

Cursor - A symbol or sign which acts as a pointer to identify one or more character spaces on the display screen of a CRT which will be affected by a command or action. For example, it may indicate where the next character to be typed will appear.

Data Store - The part of a terminal in which received data is held during operation. A method of storing data, usually in binary coded form.

Delete - The ability to remove extraneous or erroneous material from screen or memory, simultaneously eliminating the gaps which would otherwise be formed.

Delimiter - A special character used to denote a boundary between adjacent syntactic components of a program; for example, a slash (/).

Display Coding - A means of highlighting displayed segments such that one segment is differentiated from other segments.

Dot Matrix Characters - Character images on a CRT display screen that are represented by an appropriate number and location of dots within a defined cell or "matrix" of dot positions.

Feedback - A response from the system which informs the user of the status of the current request or command.

Fixed Function Key - A function key that is not readily changeable.

Flexibility - A system is flexible to the degree that individual differences in skill are encompassed to ensure optimal performance of all users under all anticipated conditions.

Flicker - A form of image instability caused by the perceived dimming and brightening of the character images as they are refreshed on the display screen.

Formatting - The structuring of the display screen into protected and accessible areas within which various actions can be performed in fields.

Form Filling - The entering of information into predefined areas or fields in the display screen. Appropriate for buffered terminals only

Function Keyset - A collection of keys, each of which is associated with a specific command.

Glare - A visual condition caused by excessive luminance variations within the field of vision, e.g., when bright sources of light such as windows or lamps or their reflected images fall in the line of sight.

Graphic Display - Display of data in the form of lines, shapes, and symbols such as graphs, histograms, maps, etc.

Hardware - The physical equipment which makes up a computer system, e.g., CPU, terminals, and other input/output (I/O) and storage devices. As opposed to the programming software.

Hierarchical - Arranged in a set of levels; tree-structured.

Illuminance - That part of the luminous flux that is incident on a unit area of a surface, i.e., a measure of the quantity of light with which a surface is illuminated. Measured in units of Lux (lx).

Interface - An electronic device which enables one piece of equipment to communicate with or control another. A shared boundary.

Label - One or more characters used to identify a statement or an item of data in a computer program.

Languages - Software framework of commands for writing a program.

Left-Justify - To display data in columns such that the first character of each row is aligned vertically.

Macro - An instruction in a source language that is equivalent to a specified sequence of machine instructions.

Memory - The part of a computer, internal to the CPU, where programs and data are stored.

Menu - A collection of items, e.g., a list or directory of the contents of a given file, from which the operator may select.

Multiuser - A system which permits multiple users to access the same system in a time-sharing mode via "time slicing" interrupts of the single CPU or via use of satellite CPUs.

Numeric Keypad - An arrangement of the 10 numeric keys in the standard telephone arrangement: 1, 2, 3 across top row; 4, 5, 6 in second row; 7, 8, 9 in third row; 0 on the bottom row.

Page Scrolling - A technique used in recalling information from the display memory in which, as the information is recalled, the entire screen content is renewed to make room for the new data. Analogous to the page-by-page presentation and indexing of printed information.

Parameter - A quantity or constant whose value varies with the circumstances of its application. A quantity with variable values used in determinining other variables.

Phosphor - A coating of luminescent material which emits visible light when struck by a beam of electrons within an evacuated glass tube such as a CRT.

Program - Set of instructions for handling data that is input into the system.

LEVELS:
- a. Languages are used to write programs.
- b. Programs combine to handle a specific application.

Reflectance - The ratio between the quantity of light that is reflected from a given surface and the total quantity of light that is incident on the same surface.

Reflected Glare - A glare condition caused by the reflection of bright sources of light, e.g., windows, luminaires, etc., from illuminated surfaces within the field of vision.

Refresh - A technique used to regularly energize the phosphor coating in the CRT in order to ensure an apparently continuous and stable, but in fact transient image.

Refresh Rate - The frequency with which the image on the face of the CRT is refreshed.

Response Time - The elapsed time between the generation of an inquiry at a data terminal and the receipt of the response at the same terminal.

Right-Justify - To display data in columns such that the last character of each row is aligned vertically.

Screen Format - The structure or layout of a visual display, e.g., column text format (narrative), tabular, divided into protected and unprotected areas, etc.

Simplicity - A system contains the quality of simplicity to the extent that information presented to the operator or entered by the operator is grouped into short, readily understandable structures.

Software - The term for all programs that run on the computer.

System - Computer plus printer-CRTs-modems plus software.

Tabular Display - Data presented in row/column format.

Terminal - An input-output (I/O) device for transmitting or receiving data on a communi-cation line.

Variable - A quantity that can assume any of a given set of values.

Variable Function Key - A function key that is readily changeable, e.g., keys that are displayed electronically on a CRT.

Workload Reasonability - A system has a reasonable workload to the extent that the tasks required by the operator are within the operator's capability and require the operator to perform a useful, meaningful role.

APPENDIX F

APPLICABLE DOCUMENTS

This appendix contains references to applicable documents which present test criteria and methods. It is recommended that the test activity obtain additional documentation depending on the types of HFE testing anticipated. The documents listed under the topic All HFE Tests have wide applicable to many HFE tests. Other references are applicable to specific test types.

TOPs are available from the Defense Technical Information Center (DTIC), Defense Logistics Agency, Cameron Station, Alexandria, VA, 22304-6145. Other TECOM documents are available from TECOM Headquarters. Federal and military specifications, standards and handbooks are available from the Naval Publications and Forms Center (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099. American National Standards Institute (ANSI) and International Standards Organization (ISO) documents can be obtained from the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018. Society for Automotive Engineers (SAE) documents can be obtained from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

All HFE Tests

MIL-STD-1472D Human Engineering Design Criteria for Military Systems, Equipment and Facilities

MIL-HDBK-759A(MI) Human Factors Engineering Design for Army Materiel (Metric) with Change Notices 1 and 2

TOP 1-1-059 Soldier-Computer Interface

AR 602-1 Human Factors Engineering Program

TECOM Regulation 70-24 Research Development and Acquisition - Documenting TECOM Testing

TOP 1-1-012 Classification of Deficiencies and Shortcomings

TECOM PAM 602-1 Questionnaire and Interview Design (Subjective Testing Techniques)

AMC Regulation 70-13 Test Incident and Related Reporting

AR 602-2 Manpower and Personnel Integration (MANPRINT) in Materiel Acquisition Processes

TECOM Regulation 70-5 Use of Soldier Operator-Maintainer Test and Evaluation (SOMTE) Personnel in Technical Testing

DARCOM PAM 706-103 Engineering Design Handbook - Selected Topics in Statistics with Army Applications

MIL-STD-12 Abbreviations for Use on Drawings, Specifications, Standards, and in Technical Documents

MIL-STD-1280 Keyboard Arrangements

MIL-STD-490 Specification Practices

MIL-STD-1801 (USAF) User/Computer Interface

Noise Measurements

MIL-STD-1474B(MI) Noise Limits for Army Materiel

TOP 1-2-608 Sound Level Measurements

SAE J88A Exterior Sound Level Measurement Procedure for Powered Mobile Construction Equipment

SAE J366B Exterior Sound Level for Heavy Trucks and Busses

ANSI S1.4 Sound Level Meters, Specifications for

ANSI S1.11 Octave, Half-Octave, and Third-Octave Filter Sets, Specifications for

ANSI S6.1 Qualifying a Sound Data Acquisition System

TB MED 501 Hearing Conservation

ANSI S1.13 Sound Pressure Levels, Method for the Measurement of

MIL-A-8806 Acoustical Noise Levels in Aircraft, General Specification for

MIL-S-008806 Sound Pressure Levels in Aircraft, General Specification for

MIL-STD-1294 Acoustical Noise Limits in Helicopters

MIL-STD-740-1 Airborne Sound Measurements and Acceptance Criteria of Shipboard Equipment

Temperature, Humidity and Environmental Control Tests

ISO 7243 Hot Environments - Estimation of the Heat Stress on Working Man, Based on the WBGT index (Wet Bulb Global Temperature) - International Standards Organization

TB MED 507 Protection, Treatment and Control of Heat Injury

TOP 2-2-708 Vehicle Personnel Heater Compatibility

TOP 6-2-516 Adequacy of Shelter and Van-Mounted Lighting, Ventilation, Air Conditioning and Heating Equipment

TOP 10-2-068 Dehumidifiers

TOP 10-2-072 Heating Equipment

TOP 10-2-145 Air Conditioners

Visibility Measurements

TOP 3-2-812 Field of Vision - Vehicles

Speech Intelligibility Tests

ANSI S3.5-1969 Articulation Index, Methods for the Calculation of

Van Cott, H.P. and Kinkade, R.G. (1972) Human Engineering Guide to Equipment Design. McGraw Hill

ANSI S3.2-1960 Monosyllabic Word Intelligibility, Method for Measurement of

TOP 6-2-242 Analog Single Channel Communication Transmitter and Receiver Tests

TOP 6-2-521 Engineering Intelligibility Testing of Voice Communication Equipment

Workspace Design and Anthropometry Tests

DOD HDBK-743 Anthropometry of US Military Personnel

Gordon, C.C., Churchill, T., Clauser, C.E., Bradtmiller, B., McConville, J.T., Tebbetts, I. and Walker, R.A. (1989). 1988 Anthropometric Survey of U.S. Army Personnel: Summary Statistics Interim Report. United States Army Natick Research, Development and Engineering Center, Natick, MA

MIL-STD-1333A Aircrew Station Geometry for Military Aircraft

TOP 2-2-802 Stowage

Alexander et. al. (1976). Effects of Encumbering Clothing, Personal Protective Equipment and Restraints on Body Size and Arm-Reach Capability of USAF Aircrewmen. Aerospace Medical Research Laboratory. Wright Patterson AFB

Kinkick C. M Anthropometry Handbook. US Army Tropic Test Center

Maintainability and Component Access Tests

MIL-STD-415 Test Provisions for Electronic Systems and Associated Equipment, Design Criteria for

TOP 2-2-503 Maintenance (Vehicle)

TOP 6-2-504 Maintenance/Maintainability

SAE J925 Minimum Access Dimensions for Construction and Industrial Machinery

Information System Tests

MIL-HDBK-761A Human Engineering Guidelines for Management Information Systems

Training Assessment Tests

TOP 1-2-609 Instructional Material Adequacy Guide and Evaluation Standard (IMAGES)

TOP 7-3-501 Personnel Training / Training Evaluation

TOP 10-2-501 Operator Training and Familiarization

Workload Assessment Tests

Aldrich, T.B., Craddock, W. & McCracken,J.H. (1984). A computer analysis to predict crew workload during LHX scout-attack missions. Volume 1: Technical Report. Fort Rucker, AL: U.S. Army Research Institute

Cooper, G.E. & Harper, R.P. (1969). *The use of pilot rating in the evaluation of aircraft handling qualities* (NASA TN-D-5153). Moffett Field, CA: NASA Ames Research Center

Donnell, M.L. (1979). The application of decision-analytic techniques to the test and evaluation phase of the acquisition of a major air system: Phase III. (Technical Report PR79-6-91). McLean, VA: Decisions and Designs Inc.

Eggleston, R.G. & Quinn, T.J. (1984). A preliminary evaluation of a projective workload assessment procedure. In *Proceedings of the Human Factors Society 28th Annual Meeting*. (pp. 695-699) San Antonio, TX: Human Factors Society

Hart, S.G. & Staveland, L.E. (1987). Development of NASA-TLX (Task Load Index): Results of empirical and theoretical research. In Hancock, P.A. and Meshkati, E. (Eds.), *Human Mental Workload*. Amsterdam: Elsevier

Lysaght, R.J., Hill, S.G., Dick, A.O., Plamondon, B.D., Linton, P.M., Wierwille, W.W., Zaklad, A.L., Bittner, A.C. & Wherry, R.J. (1989). Operator workload: comprehensive review and evaluation of operator workload methodologies. Technical Report 851. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences

Reid,G.B., Shingledecker, C.A. & Eggemeier, F.T. (1981). Application of conjoint measurement to workload scale development. In *Proceedings of the Human Factors Society 25th Annual Meeting*. Rochester, NY: Human Factors Society.

Vidulich, M.A. & Tsang, P.S. (1987) Absolute magnitude estimation and relative judgment approaches to subjective workload assessment. In *Proceedings of the Human Factors Society 31st Annual Meeting*. (pp. 1057-1061). Anaheim, California: Human Factors Society.

Cold Regions Equipment and Clothing Tests

TOP 1-1-003 Arctic Personnel Effects

TOP 8-4-006 Arctic Environmental Tests of CB Protective Clothing, Protective Masks and Winterization Kits

TOP 10-2-509 Cold Regions Performance Test of Snowshoes

TOP 10-2-510 Cold Regions Environmental Protection and Durability Test of Clothing

TOP 10-3-512 Cold Regions Environmental Test of Boot and Similar Footwear

TOP 10-4-004 Arctic Environmental Test of Rations

TOP 10-4-005 Arctic Environmental Test of Clothing and Sleeping Equipment

TOP 10-4-007 Arctic Environment Test of Skis and Snowshoes

TOP 10-4-008 Arctic Environmental Test of Individual Load-Carrying Equipment

TOP 9-4-006 Cold Regions Logistic Supportability Testing of Construction, Support and Service Equipment

TOP 10-4-500 Arctic Preoperational Inspection, Physical Characteristics, Human Factors, and Maintenance Evaluation

Tropic Conditions Equipment Tests

TOP 1-1-054 Ground-to-Ground Target Detection in Tropic Forests

TOP 9-4-003 Construction, Support, and Service Equipment

TOP 10-4-003 General Supplies and Equipment

Packaging, Loading and Transportability Tests

TOP 1-2-500 Transportability

TOP 2-2-537 Cargo Loading Adaptability

TOP 10-2-211 Packaging and Containers

Erectability Tests

TOP 6-3-505 Emplacement, Action, and March Order

Air Vehicles - Aircrew Station and Aircrew Equipment Tests

MIL-M-18012 Markings for Aircrew Station Displays, Design and Configuration of

MIL-STD-203 Aircrew Station Controls and Displays for Rotary Wing Aircraft

MIL-STD-250 Aircrew Station Controls and Displays for Fixed Wing Aircraft

MIL-C-25050 Colors, Aeronautical Lights and Lighting Equipment, General Requirements for

MIL-STD-850 Aircrew Station Visual Requirements for Military Aircraft

MIL-S-18471 System, Aircrew Automated Escape, Ejection Seat Type: General Specifications for

MIL-STD-1247 Markings, Functions and Hazard Designations of Hose, Pipe, and Tube Lines for Aircraft, Missiles and Space Systems

MIL-STD-783 Legends for Use in Aircrew Stations and on Airborne Equipment

MIL-STD-411 Aircrew Station Signals

MIL-L-5667 Lighting Equipment, Aircraft Instrument Panel, General Specification for Installation of

MIL-L-25467 Lighting, Integral, Red, Aircraft Instrument, General Specification for

MIL-STD-490 Specification Practices

MIL-STD-850B Aircrew Station Vision Requirements for Military Aircraft

TOP 7-2-085 Helmets (Aviation)

TOP 7-3-085 Helmets (Aviation)

TOP 7-2-086 Oxygen and Protective Masks (Aviation)

TOP 7-3-086 Oxygen and Protective Masks (Aviation)

TOP 7-2-087 Clothing (Aviation)

TOP 7-3-087 Clothing (Aviation)

TOP 7-2-095 Survival Equipment (Aviation)

TOP 7-3-095 Survival Equipment (Aviation)

Troop Support Equipment Tests

TOP 10-2-021 Combat Uniforms and Protective Equipment

TOP 10-2-023 Individual Load Carrying Equipment

TOP 10-2-036 Field Heating and Cooking Equipment

TOP 10-2-160 Sleeping Gear

TOP 10-2-175 Tents and Shelters

TOP 10-2-205 Clothing, Combat Vehicle Crewman

TOP 10-2-206 Body Armor

TOP 10-2-207 Rations

TOP 10-2-209 Food Acceptance Surveys

Safety Tests

TOP 2-2-508 Automotive Safety and Health Hazard Evaluation

TOP 2-2-614 Toxic Hazards Tests for Vehicles and Other Equipment

TOP 2-2-808 Field Shock and Vibration Tests of Vehicles

TOP 3-2-503 Safety Evaluation of Fire Control Systems - Electrical and Electronic Equipment

TOP 3-2-504 Safety Evaluation of Hand and Shoulder Weapons

TOP 4-2-502 Safety Evaluation of Mines and Demolitions

TOP 4-2-503 Safety Evaluation - Close Support Rockets and Missiles

TOP 4-2-504 Safety Testing of Artillery, Mortar, and Recoilless Rifle Ammunition

TOP 7-3-506 Safety (Aviation Materiel)

TOP 8-2-553 Safety Evaluation - CB Items

TOP 10-2-508 Safety and Health Hazard Evaluation - General Equipment

APPENDIX G

METRIC/ENGLISH CONVERSION FACTORS

	To Convert From:	To:	Multiply By:
Length	Inches (in)	Millimeters (mm)	25.4
	Inches (in)	Centimeters (cm)	2.54
	Inches (in)	Meters (m)	0.0254
	Feet (ft)	Meters (m)	0.3048
	Millimeters (mm)	Inches (in)	0.03937
	Centimeters (cm)	Inches (in)	0.3937
	Meters (m)	Inches (in)	39.3700
	Meters (m)	Feet (ft)	3.2808
Area	Square Inches (in^2)	Square Centimeters (cm^2)	6.4516
	Square Feet (ft^2)	Square Meters (m^2)	0.0929
	Square Centimeters (cm^2)	Square Inches (in^2)	0.155
	Square Meters (m^2)	Square Feet (ft^2)	10.764
Volume	Cubic Inches (in^3)	Cubic Centimeters (cm^3)	16.3872
	Cubic Feet (ft^3)	Cubic Meters (m^3)	0.02832
	Cubic Centimeters (cm^3)	Cubic Inches (in^3)	0.061
	Cubic Meters (m^3)	Cubic Feet (ft^3)	35.3144
Force	Ounces (oz)	Newtons (N)	0.278
	Pounds (lb)	Newtons (N)	4.4482
	Newtons (N)	Ounces (oz)	3.5969
	Newtons (N)	Pounds (lb)	0.2248
Weight	Pounds (lb)	Kilograms (kg)	0.4536
	Kilograms (kg)	Pounds (lb)	2.2046
Torque	Inch-Ounces (in-oz)	Newton-Meters (N-m)	0.0071
	Inch-Pounds (in-lbs)	Newton-Meters (N-m)	0.113
	Foot-Pounds (ft-lb)	Newton-Meters (N-m)	0.0094
	Newton-Meters (N-m)	Inch-Ounces (in-oz)	141.603
	Newton-Meters (N-m)	Inch-Pounds (in-lbs)	8.85
	Newton-Meters (N-m)	Foot-Pounds (ft-lb)	106.383

	To Convert From:	To:	Multiply By:
Angle	Arc Seconds (sec)	Milliradians (mrad)	0.00485
	Arc Minutes (min)	Milliradians (mrad)	0.2909
	Degrees (°)	Radians (rad)	0.01745
	Milliradians (mrad)	Arc Seconds (sec)	206.28
	Milliradians (mrad)	Arc Minutes (min)	3.438
	Radians (rad)	Degrees (°)	57.3
Illuminance	Foot Candles (ft-C)	Lux	10.764
	Lux	Foot-Candles (ft-C)	0.0929
Luminance	Foot Lamberts (ft-L)	Candela/Meter2 (cd/m^2)	3.4258
	Candela/Meter2 (cd/m^2)	Foot Lamberts (ft-L)	0.2919

	To Convert From:	To:
Temperature	Degrees Fahrenheit (°F)	Degrees Centigrade (°C)
	$°C = \frac{5}{9}(°F - 32)$	
	Degrees Centigrade (°C)	Degrees Fahrenheit (°F)
	$°F = \frac{9}{5}(°C) + 32$	

AMSTE-RP-702-100
Test Operations Procedure 1-2-610
AD No.

15 May 1990

U.S. ARMY

TEST AND EVALUATION COMMAND

HUMAN FACTORS ENGINEERING
PART II

HEDGE

HUMAN FACTORS ENGINEERING DATA GUIDE FOR EVALUATION

Approved for public release; distribution unlimited

The criteria contained in this document reflect those in effect on the date of publication. Test requirements and criteria referred to as Design Requirements are contained in the current issue of MIL-STD-1472 which shall have precedence in case of conflict.

TOP 1-2-610 Part II

Human Factors Engineering Data Guide for Evaluation

HEDGE

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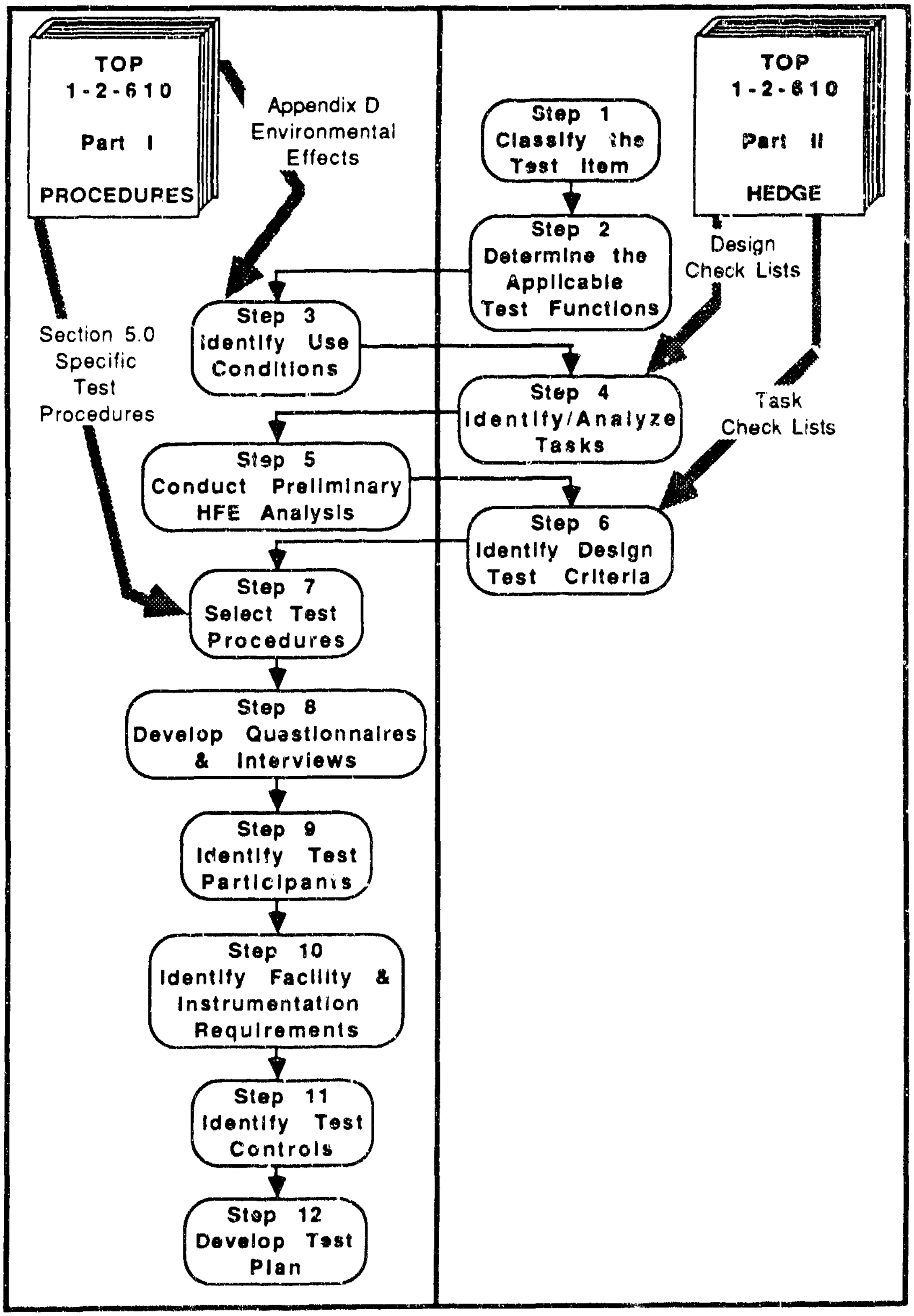

Figure 1. Steps in Preparation for an HFE Test

1.0 STEPS IN PREPARATION FOR AN HFE TEST

Prior to using HEDGE to plan an HFE test, obtain copies of the following for the test item:

a. TECOM Independent Assessment Plan (IAP), Army Materiel Systems Analysis Activity (AMSAA) Independent Evaluation Plan (IEP) or AMSAA Test Design Plan (TDP)
b. System MANPRINT Management Plan
c. Technical Manuals
d. Required Operational Capability (ROC) and/or System Specification

To get copies of these documents, contact:

a. the Test Activity Test Director
b. the HFE counterpart in the RAM/ILS/HFE Division at TECOM HQ
c. the TD&E Officer at AMSAA
d. the Test or Assessment Officer at TECOM HQ

Part II of TOP 1-2-610 is the Human Factors Engineering Data Guide for Evaluation (HEDGE). HEDGE is intended to accompany Part I of the TOP and to provide data, references and guidance in conducting the test preparation steps described in Part I. The steps are as follows:

1. Classify the Test Item
2. Determine the Applicable Test Functions
3. Identify Use Conditions
4. Identify/Analyze Operator/Maintainer Tasks
5. Conduct Preliminary Human Factors Engineering Analysis
6. Identify Design Test Criteria
7. Select Test Procedures
8. Develop Questionnaires and Interviews
9. Identify Test Participants
10. Identify Test Facility and Instrumentation Requirements
11. Identify Test Controls
12. Develop Test Plan

The test preparation steps are shown in FIGURE 1. The left side of FIGURE 1 shows test preparation steps for which TOP 1-2-610 Part I is the primary source of information while the right side shows steps for which HEDGE is used. HEDGE is primarily applicable to the following steps:

1. Classify the Test Item
2. Determine the Applicable Test Functions
4. Identify/Analyze Operator/Maintainer Tasks
6. Identify Design Test Criteria

INDEX TO TEST ITEM CLASS / SUBCLASS AND TEST FUNCTIONS

Test Item Class	Test Item Subclass	Examples	OPERABILITY	MAINTAINABILITY	TRANSPORTABILITY	PORTABILITY/USABILITY	ERECTABILITY	HABITABILITY
I. VEHICLES	A. Maneuvering	Trucks, Boats, Landing Craft, Tanks, Aircraft, Self Propelled Guns	•	•	•			
	B. Air	Airplanes, Gliders, Helicopters	•	•	•			
	C. Non-Maneuvering	Vans, Railroad Cars, Barges, Cargo Trailers	•	•	•			
II. WEAPONS	A. Individual	Rifles, Sidearms, Aircraft Mounted Weapons, Hand Grenades	•	•		•		
	B. Crew Served	Howitzers, Mortars, Missile Sites, Anti-Aircraft Guns, Tank Mounted Guns	•	•	•	•	•	
	C. Ammunition	Bombs, Artillery Rounds, Mines, Missiles Demolition Explosives, Clip & Belt Ammunition			•	•		
III. MATERIEL HANDLERS	A. Soldier-Operated	Cranes, Booms, Winches, Power Shovels, Hand Trucks, Fork Lifts, Sleds	•	•	•		•	
	B. Soldier-Monitored	Conveyor Belts, Chutes, Hoses, POL Storage & Distribution, Liquid Loaders, Pressure Cylinders	•	•	•			
IV. ELECTRONICS/ SIGNALS	A. Sensors & Detectors	Radars, Mine Detectors, Range Finders, Proximity Sensors, Radiation & Chemical Sensors	•	•	•	•		
	B. Information/ Command-Control Systems	Recorders, Information Retrieval & Optical Systems, Amplifiers, Avionics, Data Processing	•	•	•	•		
V. OPERATIONAL SUPPORT	A. Maintenance & Repair Equipment	Hand Tools, Service & Lubrication Equipment, Inspection Devices, Pipeline Cleaners	•	•	•			
	B. Materiel Production & Environmental Control	Printing Presses, Bakeries, Machine Tools, Dust Controllers, Dehimidifiers, Noise Attenuators	•	•	•			
	C. Major Construction Items	Erection Kits, Portable Shelters, Prefabricated Buildings, Towers, Antennas			•		•	
VI. TROOP SUPPORT	A. Consumables	Foods, Medical Supplies, Skin Ointments	•		•			
	B. Clothing	Protective, Regular				•		
	C. Personal Equipment	Protective Equipment, Mess Gear, Back Packs, Sleeping Gear, Entrenching Tools, Skis				•		
	D. Living & Working Areas	Tents, Shelters, Vans						•

Figure 2. Index to Test Item Class/Subclass and Test Functions

2.0 HOW TO USE HEDGE

2.1 Step 1 - Classify The Test Item Test Item Classes, Subclasses and examples are listed in FIGURE 2. FIGURE 2 shows the major Classes and the Subclasses according to which HEDGE is arranged. Identify the Test Item Class which best defines the item you are going to test. Then identify the Subclass which best defines the test item. Definitions of Test Item Classes and Subclasses are provided below:

I. **VEHICLES** - Items that move personnel or materiel from place to place.
   - A. **Maneuvering** - Items that use their own power on land or water.
   - B. **Air** - Items that move through the air.
   - C. **Non-Maneuvering** - Items that use a prime mover.

II. **WEAPONS** - Items that are used in offensive or defensive combat.
   - A. **Individual** - Items that are used by a single soldier.
   - B. **Crew Served** - Items that are operated by two or more soldiers.
   - C. **Ammunition** - Explosive items used in weapons as well as those that are complete weapons within themselves.

III. **MATERIEL HANDLERS** - Items that distribute or move materiel.
   - A. **Soldier-Operated** - Items requiring direct action by an individual for loading, distributing or moving materiel.
   - B. **Soldier-Monitored** - Items in which the personnel function is limited to initiating, monitoring and terminating the loading, distributing or moving of materiel. The monitoring function will include verification and such corrective action as may be required.

IV. **ELECTRONICS/SIGNALS** - Items used for transmitting, receiving, disseminating and storing of information.
   - A. **Sensors & Detectors** - Items that detect the presence of metals, electromagnetic or nuclear radiation, noxious gasses or other objects.
   - B. **Information/Command-Control Systems** - Items used in the collection, processing and presentation of data.

V. **OPERATIONAL SUPPORT** - Items used in construction, production and maintenance of materiel, control of the environment, or performance of various troop and unit support services.
   - A. **Maintenance & Repair Equipment** - Items used to assemble, maintain and repair equipment.
   - B. **Materiel Production & Environmental Control** - Items used to control or modify the environment.
   - C. **Major Construction Items** - Oversized items requiring major assembly.

VI. **TROOP SUPPORT EQUIPMENT** - Items primarily used for individual troop support and subsistence.
   - A. **Consumables** - Items eaten, drunk or medicinally used.
   - B. **Clothing** - Items protecting the body under normal or emergency conditions.
   - C. **Personal Equipment** - Items carried and/or used by an individual.
   - D. **Living & Working Areas** - Items used by personnel while working or relaxing.

2.2 Step 2 - Determine the Applicable Test Functions Test Functions describe, in general or at the top level, how the test item is used. FIGURE 2 shows the Test Functions which are often found to be applicable to test items depending on the Test Item Class and Subclass from Step 1. However, the test item documentation should be reviewed to determine all applicable Test Functions whether or not they are indicated as applicable in FIGURE 2. Definitions of Test Functions are provided below:

2.2.1 <u>OPERABILITY</u> The purpose of this test function is to determine the adequacy of the operator/machine interface to perform in conformance with the requirements stated in the military and technical characteristics and standard military specifications. The emphasis in Operability testing is on the adequacy of the design for performance of operator tasks involved in the functioning of the test item for the intended mission.

The Operability Test Function addresses, but is not limited to, test item components and procedures required for:

a. Item set-up.

b. Inter-connection with other items.

c. Operational check-out.

d. Adjustments, calibration and verifying connections.

e. Gaining access and egress.

f. Activation and deactivation of item.

g. Performance of required functions.

h. Accommodation of item and operator to applicable operating conditions.

2.2.2 <u>MAINTAINABILITY</u> The purpose of this Test Function is to determine if the test item can be maintained under field conditions at the level specified by the directive. In some cases the maintenance requirements will be precisely defined. In others, you will have to make this determination based on your familiarity with similar items. The emphasis in Maintainability testing is on the adequacy of the design for performance of maintainer tasks involved in diagnosis, unit replacement and fault correction necessary to maintain the functional status of the item.

The Maintainability Test Function addresses, but is not limited to, test item components and procedures required for:

a. Routine operator-performed preventive maintenance checks and tasks (scheduled maintenance).

b. Contingency tasks at the field operator level (non-scheduled maintenance).

c. Detection of malfunctions.

d. Troubleshooting.

e. Removal, repair and replacement of components.

2.2.3 <u>TRANSPORTABILITY</u> The purpose of this Test Function is to evaluate the test item for adequacy of the human factors aspects of moving the item by rail, air, water or land. Many of the items tested by TECOM are tested for this aspect only (i.e. missile trailers, weapons, various types of electronic gear, etc.). Some of the items which appear at first to require only Transportability testing may be found to involve soldier/item interactions to which other test functions are applicable. A line-haul test of a vehicle, for example, may involve the engineering testing of operating components, but also require that it can be driven and maintained during the test. If the item should be

evaluated based on the ability of operators to drive it, then the Operability Test Function will also be applicable. Similarly, if the item should be evaluated for maintenance design, then the Maintainability Test Function will be applicable.

When the test is limited to those aspects of an item which pertain to transporting it by means other than its own power, then the Transportability Test Function is applicable. This addresses, but is not limited to test item components and procedures for:

a. Preparation of the item for transfer including crating, removal of projecting components, fastening down of loose elements and installation of moving blocks, braces pads, etc.

b. Attachment of cables, hooks, etc. to the item.

c. Pushing, sliding or lifting the item.

d. Fastening down of the item in the carrier vehicle.

2.2.4 PORTABILITY/USABILITY The purpose of this Test Function is to determine whether the item can be carried and used as designed by a fully encumbered combat soldier and also to determine if it will interfere with the performance of other tasks required of the soldier.

The Portability/Usability Test Function addresses, but is not limited to, test item components and procedures for:

a. Preparing the item for carrying including disassembly, retraction of elements, placement in carrying case, etc.

b. Securing item on body via belt, pack, carrying case, etc.

c. Lifting and transporting item.

d. Performing required tasks with item attached to body.

e. Unloading item.

f. Use of item in a combat situation.

2.2.5 ERECTABILITY The purpose of this Test Function is to determine the adequacy of the design of a test item for assembly under field conditions where the assembly function is considered to be of primary importance. Examples include bridges, pipelines, prefabricated buildings and power sources. The Operability Test Function may also be applicable after the test item has been erected/assembled.

The Erectability Test Function addresses, but is not limited to, test item components and procedures for:

a. Pre-erection alignment of parts.

b. Connection of components.

c. Sealing of joints.

d. Testing of item integrity after erection.

e. Disassembly of item after use.

2.2.6 HABITABILITY The purpose of this Test Function is to determine whether the design of items such as tents, shelters or buildings allows personnel inhabiting them to live, work and move about in the internal space.

The Habitability Test Function addresses, but is not limited to, test item components and procedures for:

a. Moving about and carrying materiel.

b. Performing duties.

c. Resting, relaxing, eating and taking care of personal hygiene.

d. Providing life support and sustaining environment.

Table 1. List of Sample Task Checklists

OPERABILITY

- I. **Vehicles**
  - A. Maneuvering
  - B. Air
  - C. Non-Maneuvering
- II. **Weapons**
  - A. Individual
  - B. Crew Served
- III. **Materiel Handlers**
  - A. Soldier-Operated
  - B. Soldier-Monitored
- IV. **Electronics/Signals**
  - A. Sensors & Detectors
  - B. Information/Command-Control Systems
- V. **Operational Support**
  - A. Maintenance & Repair Equipment
  - B. Materiel Production & Environment Control
- VI. **Troop Support Equipment**
  - A. Consumables

MAINTAINABILITY

- I. **Vehicles**
- II. **Weapons**
- III. **Materiel Handlers**
- IV. **Electronics/Signals**
- V. **Operational Support**

TRANSPORTABILITY

PORTABILITY/USABILITY (Clothing and Personal Equipment)

ERECTABILITY

HABITABILITY

2.3 Step 3 - Identify Use Conditions Identification of conditions under which the item may be operated and which may affect the evaluation is carried out using considerations presented in section 3.3 of TOP 1-2-610 Part I. Appendix D of Part I is particularly applicable in identifying environmental conditions which may affect operator/maintainer performance.

2.4 Step 4 - Identify/Analyze Operator/Maintainer Tasks One of the primary objectives of HFE testing is to verify that design characteristics of the test item are or are not adequate to support the intended use of the item. The intended use is best specified by a set of tasks which the operator/maintainer will perform. Types of Soldier/Item Tasks which are applicable to a particular test item can be identified using the Sample Task Checklists contained in Appendix A of HEDGE as a point of departure. Once the test item has been classified in Step 1 and the applicable Test Functions identified in Step 2, the applicable Sample Task Checklists will follow.

Appendix A of HEDGE contains Sample Task Checklists which are organized by applicable Test Function, Test Item Class and Subclass. Operability Task Checklists are organized by Test Item Class and Subclass. Maintainability Task Checklists are organized by Test Item Class only. Task Checklists for Transportability, Portability/Usability, Erectability and Habitability are can be used for any Item to which these Test Functions are applicable regardless of Test Item Class. The available Sample Task Checklists in Appendix A of HEDGE are listed in TABLE 1. Those applicable to the test item should be identified based on the Test Item Class and Subclass and on the applicable Test Functions.

Once a set of tasks has been defined for each of the applicable test functions, Task Checklists can then be used to verify that the design is adequate for performance of the task or that a human factors engineering problem exists for the task. Identification of tasks to be analyzed begins with a review of the test support data package accompanying the test directive and test item.

2.4.1 Task Identification and Analysis Sources of Soldier/Item Task information may include any or all of the following:

a. Contractor Task Analyses In some cases results of task analyses performed by the contractor will be included in the test item data package, or descriptions of tasks to be assessed may be provided.

b. Generic Soldier/Item Tasks Generic task names are identified in the Sample Task Checklists in Appendix A of HEDGE. Tasks in the categories identified will often be found to be associated with a test item in a particular class as determined in Step 1 . The generic tasks, however, will need to be modified to represent specific tasks performed in connection with the test item. Certain generic tasks will not be applicable and will need to be deleted. Other item specific tasks not addressed in the generic Task Checklists will need to be added.

c. Test Item Operating and Maintenance Manuals Test item technical manuals are essential data in the identification of Soldier/Item Tasks. Frequently the Generic Tasks from HEDGE Appendix A can be used to suggest potentially applicable generic tasks which can then be changed to item specific tasks using procedural information from the test item manuals.

d. Operator/Maintainer Experience Walk-Throughs and/or Talk-Throughs with trained and experienced operators/maintainers using the actual equipment can serve as a valuable source of task information. This method can be used as a primary source of task data in conjunction with other sources

listed above or can be used to verify tasks and task characteristics identified using the other sources.

At a minimum, all high and moderate criticality tasks shall be identified as defined in paragraph 2.4.2. The test plan will be organized to verify suitability of design characteristics for the performance of these tasks or to detect HFE problems in task performance. All critical tasks shall be recorded on the Preliminary HF Analysis form provided in Appendix A of TOP 1-2-610 Part I.

2.4.2 Task Criticality Definitions The criticality analysis is performed at two levels. The initial analysis is conducted to identify critical tasks or those which must be included in the evaluation. The second level analysis is conducted to identify performance requirements associated with the critical tasks. Task criticality is classified at three levels: High criticality, Moderate criticality, and Low criticality. All tasks are to be observed and those tasks which are judged to be of High or Moderate criticality shall be included in the plan. The criticality scaling dimensions are as follows:

2.4.2.1 High Criticality A task is judged of High criticality if its performance or failure to perform it properly results in: (1) hazardous or unsafe conditions for personnel using, maintaining, or depending on the equipment, or (2) in the destruction or impaired performance of a major tactical end item (missile, tank, vehicle).

2.4.2.2 Moderate Criticality A task is judged of Moderate criticality if its performance or failure to perform it properly results in: (1) immediate or ultimate failure of the equipment or component or immediate cessation of the operation; (2) reduced usability or inefficient performance of a major component of the equipment; or (3) unnecessary difficulty or significant loss of time to the operator/maintainer.

2.4.2.3 Low Criticality A task is judged of Low criticality if its performance or failure to perform has no substantial effect on the performance of the equipment or on the safety of the operator/maintainer. It may result in minor degradation in subsystem performance but no significant degradation in overall system performance.

2.4.3 Criticality Analysis When the critical tasks and task sequence have been identified, an analysis shall be performed to determine:

a. Who performs the task?

b. What performance criteria apply to the task (time, rate, sequence, etc.)?

c. If controls and displays are involved?

d. What information input is required from other personnel?

e. What commands are required from other personnel?

f. Any potential errors associated with the task?

g. How the operator or HFE specialist knows that an error has occurred (feedback)?

h. What environmental conditions (both climatological and technical or equipment produced) may be expected to influence performance of the task?

i. What conditions specific to the operation will affect performance of the task (body size, clothing, skill level)?

2.4.4 Tailored Task Checklists As the sequence of tasks is identified, a Task Checklist appropriate to the Test Item Class and Subclass shall be completed. This involves developing an item-specific task checklist from the appropriate generic Soldier/Item Task Checklists in Appendix A of HEDGE, adding any other tasks judged to be of high or moderate criticality and deleting generic tasks found not applicable to the test item. The Task Checklist must be completed at this point in the planning process so that it can be used to identify potential problems and areas where further investigation will be required in the HFE test.

2.5. Step 5 - Conduct Preliminary Human Factors Engineering Analysis The Preliminary Human Factors Engineering Analysis is conducted as described in section 3.5 of TOP 1-2-610 Part I.

2.6. Step 6 - Identify Design Test Criteria Design criteria against which items are tested are the standard HFE criteria which specify limits of forces, dimensions, workspace, noise, visibility constraints, weights, clearances, arrangements, and operational conditions. These criteria, derived from MIL-STD-1472D and other applicable military standards and specifications, are contained in a set of Sample Design Checklists which are included in Appendix B of HEDGE.

2.6.1 Using Design Checklists. The Sample Design Checklists serve two purposes. First, they provide an index to the design criteria contained in MIL-STD-1472D and other HFE documents. Second, the Design Checklists can be modified by deleting checklist items which are not applicable to the test item and adding applicable checklist items. The item-specific Design Checklists can then be used for data collection.

2.6.2 Design Checklist and Test Item Component Definitions The Design Checklists in Appendix B of HEDGE are organized by Test Item Components and are listed in TABLE 2. Definitions of the classes of components to which these checklists apply are given below.

2.6.2.1 LABELS, MANUALS & MARKINGS support identification of components and provide technical guidance in the form of written material, schematics, diagrams, illustrations and instruction plates. They also inform the operator/maintainer of hazards and provide special guidance or instructions.

2.6.2.2 STEPS, LADDERS, PLATFORMS, HANDHOLDS & RAILINGS provide surfaces and grasp points to accommodate the user's feet and hands while climbing on and accessing the test item and in transporting loads. Wheels, hubs and structural members used for foot surfaces while climbing are evaluated as ladders. Door handles, structural members, etc. used for gripping or balance are evaluated as handholds.

2.6.2.3 DOORS, HATCHES & PASSAGES provide a means for entering and leaving the workspace or openings for loading or unloading materiel. Components are evaluated for both normal and emergency use. Some doors serve dual purposes and are also evaluated as steps, ramps or platforms.

2.6.2.4 EXTERNAL COMPONENTS includes components outside of the cab or normal working position which are involved in checkout and are necessary for operation, loading, tiedown, etc. External components include such things as tires, tracks, lights, batteries, vent pipes, fill pipes, test points, indicators, dip sticks, winches, starter cranks, pulleys, material handlers, jacks, etc.

Table 2. List of Sample Design Checklists

1. LABELS, MANUALS & MARKINGS
2. STEPS, LADDERS, PLATFORMS, HANDHOLDS & RAILINGS
3. DOORS, HATCHES & PASSAGES
4. EXTERNAL COMPONENTS
5. CONTROLS
6. SPECIAL CONTROLS
7. DISPLAYS
8. SPECIAL DISPLAYS
9. COMMUNICATIONS
10. LINES, HOSES AND CABLES
11. WORKSPACE
12. FASTENERS & CONNECTORS
13. HANDLES
14. OPTICS
15. OPERATING ELEMENTS
16. PACKAGING
17. ACCESSES, COVERS & CAPS
18. MEASURES
19. REPLACEABLE UNITS
20. TEST ELEMENTS & TOOLS
21. CLOTHING & PERSONAL EQUIPMENT
22. STRUCTURAL COMPONENTS

2.6.2.5 CONTROLS includes components used to activate, deactivate and modify the equipment power and to modulate the operating elements. Controls are manipulated by operators/maintainers to change the state of item components or to increase/decrease system output. The CONTROLS checklists address controls in general and specific types of controls such as rotary switches, toggle switches, joysticks, levers, pedals, keyboards, etc. Controls evaluated are those associated with the test item, not with equipment placed on or in it.

2.6.2.6 SPECIAL CONTROLS includes controls for special purposes which are used only on specific equipment and which are an addition to the normal complement of controls. They are associated largely with aircraft.

2.6.2.7 DISPLAYS are components that provide visual and auditory information to the operator concerning the status of operation. Displays also provide indication of equipment malfunctions. The DISPLAYS checklists address displays in general and specific types of displays such as transilluminated displays, CRTs, counters, etc. Displays evaluated are those associated with the test item, not with equipment placed on or in it.

2.6.2.8 SPECIAL DISPLAYS includes displays for special purposes which are used only on specific equipment and which are an addition to the normal complement of displays. They are associated largely with aircraft.

2.6.2.9 COMMUNICATIONS includes devices and techniques for exchange of information between soldiers who constitute the crew of the test item, between the crew and externally located individuals, and between the crew and remotely located personnel. Antennas are included where applicable.

2.6.2.10 LINES, HOSES AND CABLES are any cables, wires, lines, hoses, pipes, vents, etc. that pass to or from the test item as well as plugs, sockets, connectors, quick-disconnect fittings, etc. for the above Components used for transport as well as those for operation are included.

2.6.2.11 WORKSPACE is the area within which the user operates/maintains the test item. This includes space for controls, displays, optics, electronic devices, weapons, and windows as well as standing areas, consoles, and seats. Workspace includes provisions for storage of and access to documentation, excess clothing, personal gear, weapons, tools, and equipment used occasionally. Where applicable, workspace also includes life support and protection of the operator/maintainer from adverse environmental effects. The WORKSPACE checklists address workspace design features in general as well as specific topics such as consoles, seating, noise, lighting, etc.

2.6.2.12 FASTENERS & CONNECTORS are securing devices used to assemble, package, or hold equipment in place. These include catches, hooks, screws, bolts, nuts, latches which are quick-release or tool-operated, and fastener and connector alignment and locking devices such as lock pins, safety wires, pins, nuts, electrical plugs, and fittings.

2.6.2.13 HANDLES are components used to grasp, hold, grip, or heft an equipment item for lifting, moving, steadying, or aiming whether the component was specifically designed as a handle or serves some other purpose and is only used incidentally as a handle. Where components not specifically designed as handles are used as handles, they should be evaluated as handles including the provision of suitable non-slip surfaces. Lack of handles where they are needed is also an HFE concern.

2.6.2.14 OPTICS are components that aid the human eye for sighting, aiming, or viewing. This includes eyepieces, reticles, filters, sighting mechanisms, range finders and viewers but does not include visual displays.

2.6.2.15 OPERATING ELEMENTS are components which directly initiate or terminate the operation of the test item. This includes triggers, fuses, cranks, etc. but does not include controls as such although the applicable criteria overlap.

2.6.2.16 PACKAGING includes components used as equipment containers for storage or transportation such as cartons, packing cases, boxes, bags, and covers that are not part of the test item but are used to store or transport it. It also includes carrying cases, protective covers, and storage boxes specifically designed for the equipment item as part of the item configuration.

2.6.2.17 ACCESSES, COVERS & CAPS includes openings in a test item that allow manipulation of controls, connection/disconnection of fasteners or connectors, visual checking of displays or components utilizing test points, and inserting or removing materials. Coverings, if any, of access openings are included.

2.6.2.18 MEASURES includes measuring devices such as spoons, containers, scales, etc. that are used to determine a specified amount of material.

2.6.2.19 REPLACEABLE UNITS addresses reservoir fill points and drains/vents for lubricants, fuel, hydraulic fluid, other liquids, air gasses, etc. It includes filters for air, fuel, oil etc. as well as electrical and electronic parts which require frequent replacement such as bulbs, fuses, modules, etc,

2.6.2.20 TEST ELEMENTS & TOOLS are common and special purpose tools and test instruments used for assembly, adjustment, calibration, alignment, etc. This includes special maintenance equipment such as lubrication points, pouring spouts, filter tubes, nozzles, etc.

2.6.2.21 CLOTHING & PERSONAL EQUIPMENT includes:

a. Bodywear includes clothing such as shirts, trousers, under-garments, jackets, protective clothing (rain, cold, NBC), and specialized apparel of various types.

b. Headwear includes helmets, fatigue and field caps, uniform hats and caps, head nets, NBC and rain covers, safety helmets, arctic hoods, and other special head gear.

c. Handwear includes wet/cold and arctic gloves and mittens as well as special purpose (anti-contact) gloves required for electrical or chemical protection.

d. Footwear includes standard combat boots, anti-mine or spike boots, dress shoes, waterproof and arctic boots, soft shoes (sneakers), socks, stockings, and shoe/boot inserts.

e. Personal Equipment includes sleeping gear such as sleeping bags, covers, blankets and air mattresses.

f. Combat Hardware includes web equipments carried on the body to contain or protect other items, packs, pack frames, harnesses, weapons and slings ammunition cases or magazines, first aid kits, binoculars, entrenching tools, field telephones, hygenic items, flashlights, gas masks, canteens, axes, compasses, goggles, life preservers, etc.

2.6.2.22 STRUCTURAL COMPONENTS are initially separate items that must be connected with other components to form sub-assemblies. This includes such things as single girders, poles, pre-assembled motorized units, doors, pipe sections, tents, etc.

2.6.3 Identifying Applicable Design Checklists Design Checklists are provided for the classes of Test Item Components shown in TABLE 2. Identification of the Design Checklists which are applicable to a test item is done using FIGURE 3. FIGURE 3 shows the Design Checklists from TABLE 2 as rows and the combinations of Test Functions and Test Item Class as columns. Applicability of Design Checklists to each Test Function and Test Item Class is indicated in FIGURE 3. FIGURE 3 should be used as a guide. Based on the Test Item Class and applicable Test Functions from Steps 1 and 2, the indicated Design Checklists are often applicable. This may or may not be the case for a particular test item, however. Design Checklists indicated in FIGURE 3 may not be applicable and Design Checklists not indicated in FIGURE 3 may be applicable.

INDEX TO DESIGN CHECKLISTS

Applicable Test Functions and Test Item Class / Subclass

Design Checklists	OPERABILITY I A. Vehicles - Maneuvering	OPERABILITY I B. Vehicles - Air	OPERABILITY I C. Vehicles - Non-Maneuvering	OPERABILITY II A. Weapons - Individual	OPERABILITY II B. Weapons - Crew Served	OPERABILITY III A. Materiel Handlers - Soldier-Operated	OPERABILITY III B. Materiel Handlers - Soldier-Monitored	OPERABILITY IV A. Elect./Signals - Sensors & Detectors	OPERABILITY IV B. Elect./Signals - Info./Com.-Cont. Syst.	OPERABILITY V A. Op. Support - Maint. & Repair Equipment	OPERABILITY V B. Op. Support - Mat. Prod. & Env. Control	OPERABILITY VI A. Troop Support - Consumables	MAINTAINABILITY I. Vehicles	MAINTAINABILITY II. Weapons	MAINTAINABILITY III. Materiel Handlers	MAINTAINABILITY IV. Electronics/Signals	MAINTAINABILITY V. Operational Support	TRANSPORTABILITY	PORTABILITY/USABILITY	ERECTABILITY	HABITABILITY
1. LABELS, MANUALS & MARKINGS	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
2. STEPS, LAD, PLAT, HAND, & RLS	•	•	•			•														•	•
3. DOORS, HATCHES & PASSAGES	•	•	•			•			•												•
4. EXTERNAL COMPONENTS	•	•	•			•							•		•						
5. CONTROLS	•	•		•	•	•	•	•	•		•					•					
6. SPECIAL CONTROLS		•																			
7. DISPLAYS	•	•			•	•	•	•	•	•	•		•	•		•	•				
8. SPECIAL DISPLAYS		•																			
9. COMMUNICATIONS	•	•	•		•	•	•		•												
10. LINES, HOSES & CABLES			•				•			•	•		•	•	•	•	•				•
11. WORKSPACE	•	•	•	•	•	•	•		•	•	•		•	•	•	•	•				•
12. FASTENERS & CONNECTORS			•	•	•		•	•	•	•	•		•	•	•	•	•	•		•	•
13. HANDLES				•	•			•		•	•	•							•		
14. OPTICS				•	•			•	•												
15. OPERATING ELEMENTS				•	•				•	•	•							•			
16. PACKAGING				•			•	•				•						•			
17. ACCESSES, COVERS & CAPS								•			•	•	•	•	•	•	•				•
18. MEASURES												•									
19. REPLACEABLE UNITS													•	•	•	•	•	•			
20. TEST ELEMENTS & TOOLS							•			•			•	•	•	•	•			•	
21. CLOTHING & PERSONAL EQUIPMENT																			•		
22. STRUCTURAL COMPONENTS																				•	

Figure 3. Index to Design Checklists

Components of the test item and functions of the test item should be reviewed to establish the applicability of Design Checklists. Task Checklists selected in Step 4 may also be useful since generic components of test item components are often included in the task descriptions. The column headings in FIGURE 3 are the same as the list of Task Checklists in TABLE 1 and applicability of a given Task Checklist will often suggest that the Design Checklists indicated in the corresponding column of FIGURE 3 will be applicable. For example, if a test item is a crew served weapon, the Sample Task Checklist for OPERABILITY - Crew Served Weapons will generally be applicable. One of the Design Checklists indicated in the OPERABILITY - Crew Served Weapons column of FIGURE 3 is Controls so the Controls Design Checklist will generally be applicable to a crew served weapon.

2.6.4 References to MIL-STD-1472D Design Checklists are provided for classes of Test Item Components. Within a particular Design Checklist, items are grouped according to HFE Considerations. Where a Design Checklist item is based on requirements of MIL-STD-1472D, a reference is provided to the appropriate paragraph in MIL-STD-1472D. If a Design Checklist item does not contain a paragraph reference, then it was taken from HFE sources other than MIL-STD-1472D and is provided for purposes of guidance. Where a MIL-STD-1472D reference is included, the referenced paragraph in MIL-STD-1472D should be consulted to determine applicability and to obtain detailed information on which to base a decision on design adequacy of the test item.

2.6.5 Design Checklist Data Data are gathered by using the checklists at each work-station or maintenance position. Indications of whether component design is adequate or inadequate on specific criteria are recorded. If the test item component is judged to be in compliance with the checklist item then the design is Adequate and the YES column is checked. If the component is not in compliance with the item then the design is Inadequate. The NO column is checked and the Comments column (and additional pages if necessary) is used to characterize the design problem.

2.6.6 Human Factors Considerations Each Design Checklist associated with a particular test item class is organized into sections which correspond to Human Factors Engineering Considerations defined as follows:

a. Functionality Functionality considerations refer to functional and structural aspects of a component as these relate to human use. One aspect of functionality is the suitability of the type of component provided (as opposed to some other type) for the intended use. Functionality considerations are directed particularly at controls and displays. Certain types of controls (toggle switches, legend switches, discrete rotary controls etc.) may be preferred for certain types of control functions. Functionality would refer to the suitability of the control type selected by the designer for the function in question. Other aspects of functionality include presence/absence of design features which facilitate or degrade operator performance and component construction/materials as these relate to human use.

b. Location and Arrangement Location and arrangement considerations refer to the positioning of a component as it affects the ability of the operator to reach, operate or manipulate it. Location and arrangement considerations include location of openings (accesses), cover and door operation, location of controls and displays relative to operator reach constraints, logical positioning of controls and displays based on use, and co-location of related components.

c. Size and Shape Size and shape considerations refer to the maximum and minimum dimensions and configuration of components for human use. Size and shape includes dimensions of components relative to anthropometric data, dimensions required for use while wearing special clothing, and the shape and contour of handles, controls, handholds, etc. to enhance both identification and use of the component.

d. Direction and Force Direction and force considerations refer to dynamic properties of components which are moved by operators in the course of use. Direction considerations focus on movement of controls relative to user expectations and to related displays. Force and resistance of controls affect their proper manipulation, and force required to operate or move components is constrained by human strength capabilities.

e. Clearance and Separation Clearance and separation considerations refer to the unobstructed space surrounding a component which allows the operator/maintainer to access the component. In operability functions, the emphasis is on separation between adjacent controls and between controls and surrounding structures. In other functions such as maintainability and erectability, emphasis is on clearance and access to components. Where appropriate, clearance and separation considerations are put forth for operators/maintainers wearing gloves, mittens, or other protective equipment.

f. Visibility and Identification Visibility and identification considerations address those aspects of a component which affect the ability of the operator/maintainer to visually access the component, to localize it, and to identify it. These considerations include location, size, shape, color, contrast,viewing distance, reflectance and illumination.

g. Use Conditions Use conditions refer to features of the item which affect usability and/or maintainability given the environmental and mission conditions under which the item will be used and characteristics of the user.

h. Safety Safety considerations refer to aspects of a test item which could cause injury to the operator/maintainer or to other personnel including preventative aspects for inclement weather or reduced visibility and accidental contact with electrical, thermal, chemical, radiation or pressurization hazards.

i. Operating Procedures Procedural considerations address operational and information aspects of a test item such as those found in operating and maintenance manuals, checklists, training materials, job aids or trouble shooting guides including hazard warning information.

2.6.7 Tailored Design Checklists As the applicable Design Checklists are identified, these should be modified to produce Design Checklists which are appropriate to the Test Item Class and Subclass. This involves developing item-specific Design Checklists from the sample Design Checklists in Appendix B by deleting checklist items which are not applicable to the test item and adding applicable checklist items.

2.7 Steps 7-12 After test preparation steps 1 through 6 have been completed using HEDGE as applicable, Steps 7 through 12 of the HFE test preparation process are accomplished using the appropriate sections of TOP 1-2-610 Part I.

APPENDIX A

SAMPLE TASK CHECKLISTS

This appendix presents a series of sample Task Checklists covering the twenty-one Test Function/Item Class/Subclass combinations listed in Figure 3 of HEDGE. These checklists should not be used verbatim. Inappropriate items should be deleted and appropriate items should be added where necessary.

TASK CHECKLIST

OPERABILITY I A

Vehicles - Maneuvering

TASK CHECKLIST

Test Function - Checklist	OPERABILITY I A
Item Class - Subclass	Vehicles - Maneuvering
Function	Gain Access/Egress
Subfunction	Climb Up/Down
Abbreviation	Climb

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N/A	Comment
1. Mount steps, ladders, or ramps.				
2. Use tires, hubs, or structural members for mounting.				
3. Use handholds or railings.				
4. Carry loads while ascending and descending.				
5. Raise load to step/platform.				
6. Read and observe warning and instruction labels.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY I A
Item Class - Subclass	Vehicles - Maneuvering
Function	Gain Access/Egress
Subfunction	Open/Close
Abbreviation	Open

Soldier/Item Tasks	YES	NO	N/A	Comment
7. Grasp door handle.				
8. Unlock or lock door latch.				
9. Unlatch or latch door.				
10. Push or pull door open or closed.				
11. Use handhold				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY I A
Item Class - Subclass	Vehicles - Maneuvering
Function	Prepare for Operation
Subfunction	Checkout
Abbreviation	Check

Soldier/Item Tasks	YES	NO	N/A	Comment
12. Visually inspect external operating components.				
13. Verify adjustments, structural integrity, and operational readiness.				
14. Follow published procedures where applicable.				
15. Input test signals to displays; read and interpret results.				
16. Determine control readiness.				
17. Set controls.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY I A
Item Class - Subclass	Vehicles - Maneuvering
Function	Prepare for Operation
Subfunction	Take/Leave Position
Abbreviation	Take

Soldier/Item Tasks	YES	NO	N/A	Comment
18. Step through entry.				
19. Take or leave seat.				
20. Doff or don clothing items.				
21. Place clothing, tools, weapons, etc., into storage area.				
22. Adjust seats, windows, belts, and mirrors.				
23. Adjust seat belts and shoulder harness.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY I A
Item Class - Subclass	Vehicles - Maneuvering
Function	Operate
Subfunction	Start/Monitor/Stop
Abbreviation	Strt

Soldier/Item Tasks	YES	NO	N / A	Comment
24. Remove restraints (wheel chocks, dock lines, etc.).				
25. Read labels.				
26. Preset operating controls (choke, throttle, gearshift, etc.).				
27. Activate vehicle.				
28. Check displays.				
29. Manipulate controls.				
30. Communicate with crew members and/or passengers.				
31. Perform post-operational check (follow procedures if applicable).				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY I A
Item Class - Subclass	Vehicles - Maneuvering
Function	Operate
Subfunction	Control Direction/Speed
Abbreviation	Cont

Soldier/Item Tasks	YES	NO	N/A	Comment
32. View external conditions by means of mirrors and windows.				
33. Check maps and charts.				
34. Identify destination and route.				
35. Operate steering control.				
36. Operate directional control.				
37. Operate speed control.				
38. Operate environment controls.				
39. Operate lighting controls.				
40. Operate visibility controls.				
41. Avoid obstacles.				
42. Communicate with crew/other vehicles/command post.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

OPERABILITY I B

Vehicles - Air

Function	Subfunction	Abbreviation	Page
Gain Access/Egress	Climb Up/Down	Climb	A-10
Gain Access/Egress	Take/Leave Position	Take	A-11
Perform Flight Operations	Checkout/Fly	Check	A-12
Perform Flight Operations	Intercept Targets	Intercept	A-13
Perform Flight Operations	Perform In-Flight Missions	Mission	A-14

TASK CHECKLIST

Test Function - Checklist	OPERABILITY I B
Item Class - Subclass	Vehicles - Air
Function	Gain Access/Egress
Subfunction	Climb Up/Down
Abbreviation	Climb

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N/A	Comment
1. Mount steps or portable ladders.				
2. Use structures for mounting.				
3. Use handholds and railings.				
4. Carry loads.				
5. Read labels and warnings.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY I B
Item Class - Subclass	Vehicles - Air
Function	Gain Access/Egress
Subfunction	Take/Leave Position
Abbreviation	Take

Soldier/Item Tasks	YES	NO	N/A	Comment
6. Open or close door or canopy.				
7. Prepare entry.				
8. Access seat area.				
9. Enter seat.				
10. Connect or disconnect G suits, cables, oxygen lines, restraints, etc.				
11. Adjust seats and restraints.				
12. Adjust visors.				
13. Remove or install safety pins.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY ! B
Item Class - Subclass	Vehicles - Air
Function	Perform Flight Operations
Subfunction	Checkout/Fly
Abbreviation	Check

Soldier/Item Tasks	YES	NO	N / A	Comment
14. Perform static check.				
15. Perform dynamic check.				
16. Taxi.				
17. Takeoff.				
18. Read displays.				
19. Cruise.				
20. Approach.				
21. Land.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY I B
Item Class - Subclass	Vehicles - Air
Function	Perform Flight Operations
Subfunction	Intercept Targets
Abbreviation	Intercept

Soldier/Item Tasks	YES	NO	N/A	Comment
22. Detect target.				
23. Locate target.				
24. Track target.				
25. Monitor spatial relationships.				
26. Identify target.				
27. Perform intercept.				
28. Read weapon display.				
29. Select weapon.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY ! B
Item Class - Subclass	Vehicles - Air
Function	Perform Flight Operations
Subfunction	Perform In-Flight Missions
Abbreviation	Mission

Soldier/Item Tasks	YES	NO	N/A	Comment
30. Remain on station.				
31. Perform ELINT.				
32. Perform ECM/ECCM.				
33. Attack.				
34. Evaluate effects of attack.				
35. Communicate.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

OPERABILITY I C

Vehicles - Non-Maneuvering

Function	Subfunction	Abbreviation	Page
Prepare for Use	Load/Unload Materiel	Load	A-16
Prepare for Use	Set Up for Use	Set Up	A-17
Connect/Disconnect	Engage Prime Mover	Eng	A-18
Connect/Disconnect	Verify Operational Status	Ver	A-19
Utilize	Gain Access/Egress	Acc	A-20
Utilize	Use as Workspace	Work	A-21

TASK CHECKLIST

Test Function - Checklist	OPERABILITY I C
Item Class - Subclass	Vehicles - Non-Maneuvering
Function	Prepare for Use
Subfunction	Load/Unload Materiel
Abbreviation	Load

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N / A	Comment
1. Mate loading position with loading device.				
2. Open or close cargo doors.				
3. Lower or raise platform or ramp.				
4. Mount steps, etc., with load.				
5. Pass load up to platform or entryway.				
6. Transfer load to storage area.				
7. Secure load in or on item.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY I C
Item Class - Subclass	Vehicles - Non-Maneuvering
Function	Prepare for Use
Subfunction	Set Up for Use
Abbreviation	Set Up

Soldier/Item Tasks	YES	NO	N/A	Comment
8. Transfer item to destination with prime mover.				
9. Install permanent equipment.				
10. Block or lock wheels.				
11. Level item.				
12. Attach temporary steps or stairs.				
13. Connect powerlines, cables, and hoses.				
14. Deploy expandable units.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY I C
Item Class - Subclass	Vehicles - Non-Maneuvering
Function	Connect/Disconnect
Subfunction	Engage Prime Mover
Abbreviation	Eng

Soldier/Item Tasks	YES	NO	N / A	Comment
15. Connect lines or hoses from mover to item.				
16. Prepare hitch or connection.				
17. Align and mate prime mover and item.				
18. Fasten or connect prime mover and item.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY I C
Item Class - Subclass	Vehicles - Non-Maneuvering
Function	Connect/Disconnect
Subfunction	Verify Operational Status
Abbreviation	Ver

Soldier/Item Tasks	YES	NO	N / A	Comment
19. Inspect hose and cable connections.				
20. Manually and visually verify connection tightness.				
21. Tighten and adjust connection.				
22. Inspect external operating components.				
23. Read labels.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY I C
Item Class - Subclass	Vehicles - Non-Maneuvering
Function	Utilize
Subfunction	Gain Access/Egress
Abbreviation	Acc

Soldier/Item Tasks	YES	NO	N/A	Comment
24. Set up removable stairs or ladders.				
25. Climb steps and footholds.				
26. Use handholds.				
27. Open or close doors or hatches.				
28. Pass through entryway.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY I C
Item Class - Subclass	Vehicles - Non-Maneuvering
Function	Utilize
Subfunction	Use as Workspace
Abbreviation	Work

Soldier/Item Tasks	YES	NO	N/A	Comment
29. Inhabit test item.				
30. Move about.				
31. Take position.				
32. Stow weapons, publications, and clothing.				
33. Communicate within/without workspace.				
34. Conduct operations.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

OPERABILITY II A

Weapons - Individual

Function	Subfunction	Abbreviation	Page
Prepare for Use	Pre-Operational Activities	Pre-Op	A-23
Prepare for Use	Assemble/Emplace	Assem	A-24
Prepare for Use	Load/Prepare	Prep	A-25
Use Weapon	Aim	Aim	A-26
Use Weapon	Fire/Cease Firing	Fire	A-27

TASK CHECKLIST

Test Function - Checklist	OPERABILITY II A
Item Class - Subclass	Weapons - Individual
Function	Prepare for Use
Subfunction	Pre-Operational Activities
Abbreviation	Pre-Op

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N / A	Comment
1. Store in or on vehicle.				
2. Unstow or unpack.				
3. Pick up or put down.				
4. Carry in hand.				
5. Carry on body.				
6. Field-strip.				
7. Clean parts.				
8. Mate parts.				
9. Tighten connections.				
10. Adjust slings.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY II A
Item Class - Subclass	Weapons - Individual
Function	Prepare for Use
Subfunction	Assemble/Emplace
Abbreviation	Assem

Soldier/Item Tasks	YES	NO	N/A	Comment
11. Mate subassemblies.				
12. Make connections.				
13. Emplace.				
14. Position for firing.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY II A
Item Class - Subclass	Weapons - Individual
Function	Prepare for Use
Subfunction	Load/Prepare
Abbreviation	Prep

Soldier/Item Tasks	YES	NO	N/A	Comment
15. Select ammunition.				
16. Mate ammunition.				
17. Activate ammunition feed.				
18. Ready sights and aiming aids.				
19. Ready aiming and tracking aids.				
20. Ready visual aids.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY II A
Item Class - Subclass	Weapons - Individual
Function	Use Weapon
Subfunction	Aim
Abbreviation	Aim

Soldier/Item Tasks	YES	NO	N/A	Comment
21. Take firing position.				
22. Position weapon for aiming.				
23. Locate target.				
24. Aim.				
25. Communicate.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY II A
Item Class - Subclass	Weapons - Individual
Function	Use Weapon
Subfunction	Fire/Cease Firing
Abbreviation	Fire

Soldier/Item Tasks	YES	NO	N/A	Comment
26. Fire designated burst.				
27. Alter aiming.				
28. Continue to fire.				
29. Communicate.				
30. Monitor firing.				
31. Verify effectiveness.				
32. Safe weapon.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

OPERABILITY II B

Weapons - Crew Served

Function	Subfunction	Abbreviation	Page
Prepare for Use	Pre-Operational Activities	Pre-Op	A-29
Prepare for Use	Assemble/Emplace	Assem	A-30
Prepare for Use	Load/Prepare	Prep	A-31
Use Weapon	Aim/Position for Firing	Aim	A-32
Use Weapon	Fire/Cease Firing	Fire	A-33

TASK CHECKLIST

Test Function - Checklist	OPERABILITY II B
Item Class - Subclass	Weapons - Crew Served
Function	Prepare for Use
Subfunction	Pre-Operational Activities
Abbreviation	Pre-Op

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N/A	Comment
1. Unpack or unstow.				
2. Select modes of operation.				
3. Perform static checkout.				
4. Perform cleaning.				
5. Tighten connections.				
6. Verify readiness.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY II B
Item Class - Subclass	Weapons - Crew Served
Function	Prepare for Use
Subfunction	Assemble/Emplace
Abbreviation	Assem

Soldier/Item Tasks	YES	NO	N / A	Comment
7. Read instructions.				
8. Mate subassemblies.				
9. Emplace weapon.				
10. Identify ammunition.				
11. Stabilize weapon.				
12. Communicate.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY II B
Item Class - Subclass	Weapons - Crew Served
Function	Prepare for Use
Subfunction	Load/Prepare
Abbreviation	Prep

Soldier/Item Tasks	YES	NO	N/A	Comment
13. Select ammunition.				
14. Ready ammunition.				
15. Ready weapon for loading.				
16. Load ammunition.				
17. Verify loading.				
18. Ready sighting and ranging devices.				
19. Ready aiming aids.				
20. Ready visual aids.				
21. Ready sensors.				
22. Ready weapon control system.				
23. Ready support systems.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY II B
Item Class - Subclass	Weapons - Crew Served
Function	Use Weapon
Subfunction	Aim/Position for Firing
Abbreviation	Aim

Soldier/Item Tasks	YES	NO	N / A	Comment
24. Position weapon for aiming.				
25. Activate aiming aids.				
26. Find target.				
27. Lay on target.				
28. Communicate.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY II B
Item Class - Subclass	Weapons - Crew Served
Function	Use Weapon
Subfunction	Fire/Cease Firing
Abbreviation	Fire

Soldier/Item Tasks	YES	NO	N/A	Comment
29. Determine when to fire.				
30. Fire.				
31. Alter aiming.				
32. Continue to fire.				
33. Communicate.				
34. Monitor firing.				
35. Verify effectiveness.				
36. Safe weapon.				
37. Configure weapon for transportation.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

OPERABILITY III A

Materiel Handlers - Soldier-Operated

Function	Subfunction	Abbreviation	Page
Gain Access/Egress	Climb Up/Down	Climb	A-35
Gain Access/Egress	Open/Close	Open	A-36
Prepare for Operation	Checkout	Check	A-37
Prepare for Operation	Take/Leave Position	Take	A-38
Handle Materiel	Engage Load	Eng	A-39
Handle Materiel	Lift/Move/Deposit Materiel	L/M	A-40

TASK CHECKLIST

Test Function - Checklist	OPERABILITY III A
Item Class - Subclass	Materiel Handlers - Soldier-Operated
Function	Gain Access/Egress
Subfunction	Climb Up/Down
Abbreviation	Climb

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N/A	Comment
1. Mount steps, ladders, ramps, etc.				
2. Use handholds.				
3. Use footholds.				
4. Carry load.				
5. Lift or lower load to or from platform or ledge.				
6. Read instructions, labels, and warnings.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY III A
Item Class - Subclass	Materiel Handlers - Soldier-Operated
Function	Gain Access/Egress
Subfunction	Open/Close
Abbreviation	Open

Soldier/Item Tasks	YES	NO	N/A	Comment
7. Grasp door handle.				
8. Unlock or lock door latch.				
9. Unlatch or latch door.				
10. Push or pull door open or shut.				
11. Use handholds.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY III A
Item Class - Subclass	Materiel Handlers - Soldier-Operated
Function	Prepare for Operation
Subfunction	Checkout
Abbreviation	Check

Soldier/Item Tasks	YES	NO	N/A	Comment
12. Visually inspect external operating components.				
13. Verify adjustment, structural integrity, and operational readiness.				
14. Input test signals to displays.				
15. Read and interpret displays.				
16. Determine control readiness.				
17. Set controls.				
18. Check load transport system.				
19. Check load lift system.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY III A
Item Class - Subclass	Materiel Handlers - Soldier-Operated
Function	Prepare for Operation
Subfunction	Take/Leave Position
Abbreviation	Take

Soldier/Item Tasks	YES	NO	N / A	Comment
20. Step into/out of work area.				
21. Take or leave seat.				
22. Move to or from operating position.				
23. Remove clothing items and encumbrances.				
24. Stow clothing/encumbrances.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY III A
Item Class - Subclass	Materiel Handlers - Soldier-Operated
Function	Handle Materiel
Subfunction	Engage Load
Abbreviation	Eng

Soldier/Item Tasks	YES	NO	N/A	Comment
25. Activate item.				
26. Position materiel handling device.				
27. Orient materiel handling device.				
28. Identify load.				
29. Move materiel handling device to load.				
30. Control direction and speed of item.				
31. Acquire load.				
32. Verify acquisition.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY III A
Item Class - Subclass	Materiel Handlers - Soldier-Operated
Function	Handle Materiel
Subfunction	Lift/Move/Deposit Materiel
Abbreviation	L/M

Soldier/Item Tasks	YES	NO	N/A	Comment
33. Read labels and instructions.				
34. Operate controls.				
35. Read and interpret displays.				
36. Lift load.				
37. Transport load.				
38. Identify deposit area.				
39. Deposit load.				
40. Monitor external objects and conditions.				
41. Communicate as required.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

OPERABILITY III B

Materiel Handlers - Soldier-Monitored

TASK CHECKLIST

Test Function - Checklist	OPERABILITY III B
Item Class - Subclass	Materiel Handlers - Soldier-Monitored
Function	Assemble/Install
Subfunction	Assemble/Disassemble
Abbreviation	Assem

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N / A	Comment
1. Unpackage items and components.				
2. Read instructions.				
3. Obtain tools.				
4. Identify parts.				
5. Assemble parts.				
6. Disassemble parts.				
7. Store parts.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY III B
Item Class - Subclass	Materiel Handlers - Soldier-Monitored
Function	Assemble/Install
Subfunction	Attach/Remove
Abbreviation	Att

Soldier/Item Tasks	YES	NO	N/A	Comment
8. Place and align item.				
9. Connect fasteners.				
10. Attach lines, hoses, cables, wires, pipes, etc.				
11. Level as necessary.				
12. Configure for use.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY III B
Item Class - Subclass	Materiel Handlers - Soldier-Monitored
Function	Prepare for Use
Subfunction	Checkout
Abbreviation	Check

Soldier/Item Tasks	YES	NO	N/A	Comment
13. Visually inspect components.				
14. Read labels.				
15. Manually verify connections.				
16. Set controls.				
17. Remove and inspect components, measurement devices, etc.				
18. Perform operational check.				
19. Verify readiness.				
20. Communicate.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY III B
Item Class - Subclass	Materiel Handlers - Soldier-Monitored
Function	Prepare for Use
Subfunction	Align/Adjust
Abbreviation	Adj

Soldier/Item Tasks	YES	NO	N / A	Comment
21. Make gross calibrations and adjustments manually.				
22. Use tools and controls for fine adjustments.				
23. Tighten connections.				
24. Realign components as required.				
25. Change control settings.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY III B
Item Class - Subclass	Materiel Handlers - Soldier-Monitored
Function	Start/Monitor/Stop
Subfunction	Initiate/Terminate
Abbreviation	Init

Soldier/Item Tasks	YES	NO	N/A	Comment
26. Take operating position.				
27. Determine when to start.				
28. Start or stop power.				
29. Operate power setting control.				
30. Begin loading and/or transferring operations.				
31. Operate controls for continued operation.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY III B
Item Class - Subclass	Materiel Handlers - Soldier-Monitored
Function	Start/Monitor/Stop
Subfunction	Monitor
Abbreviation	Mon

Soldier/Item Tasks	YES	NO	N / A	Comment
32. Observe operation.				
33. Observe status.				
34. Observe performance.				
35. Determine rate of flow.				
36. Obtain samples.				
37. Identify problems.				
38. Communicate.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

OPERABILITY IV A

Electronics/Signals - Sensors & Detectors

Function	Subfunction	Abbreviation	Page
Prepare for Use	Unpack/Assemble	Assem	A-49
Prepare for Use	Configure for Use	Config	A-50
Utilize	Position for Use	Posit	A-51
Utilize	Activate/Adjust/Deactivate	Act	A-52
Monitor Information Feedback	Acquire/Interpret Information	Acq	A-53
Monitor Information Feedback	Determine Operational Status	Stat	A-54

TASK CHECKLIST

Test Function - Checklist	OPERABILITY IV A
Item Class - Subclass	Electronics/Signals - Sensors & Detectors
Function	Prepare for Use
Subfunction	Unpack/Assemble
Abbreviation	Assem

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N / A	Comment
1. Read special handling instructions.				
2. Identify sensor.				
3. Retrieve from storage.				
4. Unpackage.				
5. Handle sensor.				
6. Deploy parts.				
7. Assemble parts.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY IV A
Item Class - Subclass	Electronics/Signals - Sensors & Detectors
Function	Prepare for Use
Subfunction	Configure for Use
Abbreviation	Config

Soldier/Item Tasks	YES	NO	N/A	Comment
8. Select modes of operation.				
9. Prepare interfaces and connections.				
10. Select technical parameters.				
11. Connect lines, cables, etc.				
12. Perform static checkout.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY IV A
Item Class - Subclass	Electronics/Signals - Sensors & Detectors
Function	Utilize
Subfunction	Position for Use
Abbreviation	Posit

Soldier/Item Tasks	YES	NO	N/A	Comment
13. If stationary: emplace, position, or orient.				
14. If moving: attach to locomotion device.				
15. Point or aim.				
16. Conceal or camouflage as required.				
17. Reorient as required.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY IV A
Item Class - Subclass	Electronics/Signals - Sensors & Detectors
Function	Utilize
Subfunction	Activate/Adjust/Deactivate
Abbreviation	Act

Soldier/Item Tasks	YES	NO	N/A	Comment
18. Activate sensor.				
19. Verify activation.				
20. Follow safety procedures.				
21. Read instructions.				
22. Communicate.				
23. Perform dynamic checkout.				
24. Perform quick deactivation.				
25. Control location, position, operation, and feedback of data.				
26. Control rate of motion and field of view.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY IV A
Item Class - Subclass	Electronics/Signals - Sensors & Detectors
Function	Monitor Information Feedback
Subfunction	Acquire/Interpret Information
Abbreviation	Acq

Soldier/Item Tasks	YES	NO	N/A	Comment
27. Activate displays.				
28. Acquire and interpret sensed data.				
29. Verify validity of sensed data.				
30. Integrate data from different sensors.				
31. Assess data quality.				
32. Assess data quantity.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY IV A
Item Class - Subclass	Electronics/Signals - Sensors & Detectors
Function	Monitor Information Feedback
Subfunction	Determine Operational Status
Abbreviation	Stat

Soldier/Item Tasks	YES	NO	N/A	Comment
33. Identify problems.				
34. Isolate problems.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

OPERABILITY IV B

Electronics/Signals - Information/Command-Control

TASK CHECKLIST

Test Function - Checklist	OPERABILITY IV B
Item Class - Subclass	Electronics/Signals - Information/Command-Control
Function	Enter/Leave Station
Subfunction	Enter Station
Abbreviation	Ent

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N / A	Comment
1. Grasp and operate door control.				
2. Push, pull, or slide door open or closed.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY IV B
Item Class - Subclass	Electronics/Signals - Information/Command-Control
Function	Enter/Leave Station
Subfunction	Take Position at Station
Abbreviation	Take

Soldier/Item Tasks	YES	NO	N/A	Comment
3. Step into or out of work area.				
4. Take or leave seat.				
5. Move to or from standing operator position.				
6. Remove excess clothing (rain, NBC, cold regions, etc.).				
7. Stow clothing, tools, packs, and other encumbrances.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY IV B
Item Class - Subclass	Electronics/Signals - Information/Command-Control
Function	Prepare for Operation
Subfunction	Configure Station
Abbreviation	Config

Soldier/Item Tasks	YES	NO	N/A	Comment
8. Adjust environment controls.				
9. Select modes of operation.				
10. Integrate with other operators.				
11. Establish command links.				
12. Make connections.				
13. Follow procedures.				
14. Communicate.				
15. Interact with support systems.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY IV B
Item Class - Subclass	Electronics/Signals - Information/Command-Control
Function	Prepare for Operation
Subfunction	Perform Checkout
Abbreviation	Check

Soldier/Item Tasks	YES	NO	N/A	Comment
16. Check control settings.				
17. Check data return quality.				
18. Check data return format.				
19. Check links.				
20. Verify operational readiness.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY IV B
Item Class - Subclass	Electronics/Signals - Information/Command-Control
Function	Operate Station
Subfunction	Acquire/Interpret Information
Abbreviation	Acq

Soldier/Item Tasks	YES	NO	N/A	Comment
21. Obtain and monitor continuous data.				
22. Obtain and monitor discrete data.				
23. Obtain and monitor status data.				
24. Obtain verification data.				
25. Identify and isolate problems.				
26. Assess requirement to modify operations.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY IV B
Item Class - Subclass	Electronics/Signals - Information/Command-Control
Function	Operate Station
Subfunction	Control/Adjust Operation
Abbreviation	Adj

Soldier/Item Tasks	YES	NO	N/A	Comment
27. Activate system and change control settings.				
28. Change system configuration.				
29. Change software.				
30. Input discrete commands.				
31. Input continuous control.				
32. Monitor computer/ communications/sensor systems.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

OPERABILITY V A

Operational Support - Maintenance & Repair

TASK CHECKLIST

Test Function - Checklist	OPERABILITY V A
Item Class - Subclass	Operational Support - Maintenance & Repair
Function	Prepare Item
Subfunction	Unstow/Configure
Abbreviation	Unst

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N / A	Comment
1. Identify parts.				
2. Unstow parts.				
3. Lay out and deploy parts.				
4. Align and adjust parts.				
5. Make connections.				
6. Assemble parts.				
7. Mate subassemblies.				
8. Prepare rigs.				
9. Read instructions.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY V A
Item Class - Subclass	Operational Support - Maintenance & Repair
Function	Prepare Item
Subfunction	Emplace/Position at Worksite
Abbreviation	Posit

Soldier/Item Tasks	YES	NO	N/A	Comment
10. Move assembly.				
11. Position and orient components.				
12. Emplace at worksite.				
13. Locate components at worksite.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY V A
Item Class - Subclass	Operational Support - Maintenance & Repair
Function	Prepare Worksite
Subfunction	Configure Workstation
Abbreviation	Config

Soldier/Item Tasks	YES	NO	N/A	Comment
14. Take position.				
15. Adjust seats.				
16. Set up station.				
17. Prepare materiel.				
18. Select operating modes.				
19. Perform checkout.				
20. Read instructions.				
21. Prepare support systems.				
22. Locate and prepare support personnel.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY V A
Item Class - Subclass	Operational Support - Maintenance & Repair
Function	Perform
Subfunction	Control/Adjust Operation
Abbreviation	Adj

Soldier/Item Tasks	YES	NO	N/A	Comment
23. Activate power.				
24. Change control settings.				
25. Perform test.				
26. Perform inspection.				
27. Perform removal/replacement.				
28. Perform repair.				
29. Perform site leveling.				
30. Perform construction.				
31. Perform resupply and refurbishment.				
32. Perform materiel erection.				
33. Emplace and orient tools.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY V A
Item Class - Subclass	Operational Support - Maintenance & Repair
Function	Perform
Subfunction	Monitor/Verify Operation
Abbreviation	Mon

Soldier/Item Tasks	YES	NO	N/A	Comment
34. Observe operations.				
35. Observe location of objects.				
36. Detect obstacles.				
37. Monitor performance.				
38. Monitor status.				
39. Verify operations.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

OPERABILITY V B

Operational Support - Materiel Production & Environmental Control

TASK CHECKLIST

Test Function - Checklist	OPERABILITY V B
Item Class - Subclass	Op. Support - Materiel Production & Environ. Control
Function	Assemble/Set Up
Subfunction	Assemble/Disassemble
Abbreviation	Assem

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N / A	Comment
1. Unstow or stow components.				
2. Read and interpret instructions and technical manuals.				
3. Identify parts.				
4. Connect components.				
5. Mate components to chassis.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY V B
Item Class - Subclass	Op. Support - Materiel Production & Environ. Control
Function	Assemble/Set Up
Subfunction	Emplace
Abbreviation	Emp

Soldier/Item Tasks	YES	NO	N/A	Comment
6. Install subassemblies.				
7. Make connections.				
8. Position for use.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY V B
Item Class - Subclass	Op. Support - Materiel Production & Environ. Control
Function	Prepare for Use
Subfunction	Align/Calibrate/Adjust
Abbreviation	Adj

Soldier/Item Tasks	YES	NO	N/A	Comment
9. Interpret technical manuals and labels.				
10. Tighten or loosen fasteners.				
11. Set and adjust controls.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY V B
Item Class - Subclass	Op. Support - Materiel Production & Environ. Control
Function	Prepare for Use
Subfunction	Service
Abbreviation	Serv

Soldier/Item Tasks	YES	NO	N / A	Comment
12. Determine status of expendables.				
13. Open or close access covers.				
14. Remove or replace filler caps.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY V B
Item Class - Subclass	Op. Support - Materiel Production & Environ. Control
Function	Utilize
Subfunction	Activate/Deactivate
Abbreviation	Act

Soldier/Item Tasks	YES	NO	N / A	Comment
15. Start gasoline engines.				
16. Ignite pilot light or burner.				
17. Turn on electrical power.				
18. Initiate air and hydraulic power.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY V B
Item Class - Subclass	Op. Support - Materiel Production & Environ. Control
Function	Utilize
Subfunction	Perform Prime Function
Abbreviation	Perf

Soldier/Item Tasks	YES	NO	N/A	Comment
19. Operate equipment according to operating manuals.				
20. Manipulate controls.				
21. Observe and monitor displays.				
22. Perform manual and tool assisted operations.				
23. Observe and test status of materiels.				
24. Remove and inspect finished product.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

OPERABILITY VI A

Troop Support Equipment - Consumables

Function	Subfunction	Abbreviation	Page
Unpackage/Package	Stow/Unstow	Stow	A-76
Unpackage/Package	Open/Close Package	Open	A-77
Prepare	Premix	Prem	A-78
Prepare	Heat/Agitate	Heat	A-79
Utilize/Consume	Apply/Remove	App	A-80
Utilize/Consume	Ingest	Ing	A-81

TASK CHECKLIST

Test Function - Checklist	OPERABILITY VI A
Item Class - Subclass	Troop Support Equipment - Consumables
Function	Unpackage/Package
Subfunction	Stow/Unstow
Abbreviation	Stow

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N/A	Comment
1. Insert item into or remove item from carrying case.				
2. Place item in or remove item from pockets, shirt, or pack.				
3. Strap or connect item to personal carrying gear.				
4. Remove large item from storage area.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY VI A
Item Class - Subclass	Troop Support Equipment - Consumables
Function	Unpackage/Package
Subfunction	Open/Close Package
Abbreviation	Open

Soldier/Item Tasks	YES	NO	N/A	Comment
5. Rip or tear plastic, foil, paper, sacks, or envelopes.				
6. Open or pierce metal or plastic containers (not recloseable).				
7. Remove or replace caps and covers.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY VI A
Item Class - Subclass	Troop Support Equipment - Consumables
Function	Prepare
Subfunction	Premix
Abbreviation	Prem

Soldier/Item Tasks	YES	NO	N/A	Comment
8. Measure water and other liquids.				
9. Measure dry materiels.				
10. Add liquid and dry materiels in correct proportions.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY VI A
Item Class - Subclass	Troop Support Equipment - Consumables
Function	Prepare
Subfunction	Heat/Agitate
Abbreviation	Heat

Soldier/Item Tasks	YES	NO	N/A	Comment
11. Place item over fire or in hot water.				
12. Empty consumable into cooking or eating utensil.				
13. Stir materiel.				
14. Agitate package.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY VI A
Item Class - Subclass	Troop Support Equipment - Consumables
Function	Utilize/Consume
Subfunction	Apply/Remove
Abbreviation	App

Soldier/Item Tasks	YES	NO	N/A	Comment
15. Remove or replace cap or cover.				
16. Obtain and prepare applicator.				
17. Clean and prepare skin.				
18. Apply or remove salve or oil.				
19. Sprinkle or spread powder.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	OPERABILITY VI A
Item Class - Subclass	Troop Support Equipment - Consumables
Function	Utilize/Consume
Subfunction	Ingest
Abbreviation	Ing

Soldier/Item Tasks	YES	NO	N / A	Comment
20. Eat or drink item.				
21. Utilize pouring or drinking spout.				
22. Dispose of wastes.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

MAINTAINABILITY I

Vehicles

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY
Item Class	Vehicles
Function	Perform Preventive Maintenance
Subfunction	Perform Routine Servicing
Abbreviation	Serv

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N/A	Comment
1. Gain access to components.				
2. Assemble tools and support equipment.				
3. Clean components.				
4. Tighten components.				
5. Adjust components.				
6. Align components.				
7. Calibrate components.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY I
Item Class	Vehicles
Function	Perform Preventive Maintenance
Subfunction	Inspect/Checkout
Abbreviation	Insp

Soldier/Item Tasks	YES	NO	N/A	Comment
8. Retrieve checklists and inspection procedure.				
9. Conduct walk around inspection.				
10. Conduct static checkout.				
11. Conduct dynamic checkout.				
12. Check fittings.				
13. Check valves.				
14. Check fluid pumps.				
15. Check flow rates.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY I
Item Class	Vehicles
Function	Perform Preventive Maintenance
Subfunction	Replenish/Resupply
Abbreviation	Replen

Soldier/Item Tasks	YES	NO	N / A	Comment
16. Remove and replace.				
17. Attach lines and hoses.				
18. Refill.				
19. Charge.				
20. Disconnect lines.				
21. Blow or clean lines.				
22. Remove covers.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY I
Item Class	Vehicles
Function	Perform Corrective Maintenance
Subfunction	Detect/Isolate Faults
Abbreviation	Det

Soldier/Item Tasks	YES	NO	N/A	Comment
23. Identify failure.				
24. Identify affected system.				
25. Identify faulty component.				
26. Identify faulty part.				
27. Read displays.				
28. Use test sets.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY I
Item Class	Vehicles
Function	Perform Corrective Maintenance
Subfunction	Prepare for Repair
Abbreviation	Prep

Soldier/Item Tasks	YES	NO	N/A	Comment
29. Configure system.				
30. Configure component.				
31. Configure part.				
32. Select tools.				
33. Configure support systems.				
34. Remove component.				
35. Disassemble component.				
36. Inspect parts.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY I
Item Class	Vehicles
Function	Perform Corrective Maintenance
Subfunction	Repair
Abbreviation	Repr

Soldier/Item Tasks	YES	NO	N / A	Comment
37. Perform electrical repair.				
38. Perform mechanical repair.				
39. Perform hydraulic repair.				
40. Remove and replace parts.				
41. Repair parts.				
42. Conduct tests.				
43. Verify readiness. (See Inspect/Checkout.)				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

MAINTAINABILITY II

Weapons

Function	Subfunction	Abbreviation	Page
Perform Preventive Maintenance	Adjust/Align	Adj	A-90
Perform Preventive Maintenance	Service	Serv	A-91
Perform Preventive Maintenance	Remove/Replace	Remv	A-92
Perform Corrective Maintenance	Troubleshoot	Trouble	A-93
Perform Corrective Maintenance	Repair	Repr	A-94
Perform Corrective Maintenance	Test & Calibration	Cal	A-95

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY II
Item Class	Weapons
Function	Perform Preventive Maintenance
Subfunction	Adjust/Align
Abbreviation	Adj

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N/A	Comment
1. Identify requirements.				
2. Consult publications.				
3 Read labels.				
4. Assemble tools.				
5. Access test points.				
6. Gain access to parts.				
7. Align and adjust parts.				
8. Use controls and tools.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY II
Item Class	Weapons
Function	Perform Preventive Maintenance
Subfunction	Service
Abbreviation	Serv

Soldier/Item Tasks	YES	NO	N/A	Comment
9. Remove covers.				
10. Access service points, drains, and parts.				
11. Lubricate item.				
12. Fill with fluid.				
13. Read displays.				
14. Disassemble.				
15. Clean components.				
16. Tighten parts.				
17. Disconnect lines.				
18. Blow or clean lines.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY II
Item Class	Weapons
Function	Perform Preventive Maintenance
Subfunction	Remove/Replace
Abbreviation	Remv

Soldier/Item Tasks	YES	NO	N/A	Comment
19. Handle expendables and replaceables.				
20. Prepare system for module removal.				
21. Prepare module for removal.				
22. Prepare workspace for module.				
23. Stow module.				
24. Install fresh module.				
25. Replace module.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY II
Item Class	Weapons
Function	Perform Corrective Maintenance
Subfunction	Troubleshoot
Abbreviation	Trouble

Soldier/Item Tasks	YES	NO	N / A	Comment
26. Detect faults.				
27. Access test points.				
28. Acquire measures and data.				
29. Interpret data.				
30. Consult publications.				
31. Isolate fault to component.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY II
Item Class	Weapons
Function	Perform Corrective Maintenance
Subfunction	Repair
Abbreviation	Repr

Soldier/Item Tasks	YES	NO	N / A	Comment
32. Assemble tools.				
33. Arrange lines and cables.				
34. Configure system.				
35. Configure support equipment.				
36. Conduct structural repair.				
37. Conduct mechanical repair.				
38. Conduct electrical repair.				
39. Disassemble component.				
40. Inspect parts.				
41. Replace parts.				
42. Repair parts.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY II
Item Class	Weapons
Function	Perform Corrective Maintenance
Subfunction	Test & Calibration
Abbreviation	Cal

Soldier/Item Tasks	YES	NO	N / A	Comment
43. Set up test stand.				
44. Obtain data.				
45. Interpret data.				
46. Consult publications.				
47. Consult calibration tables.				
48. Validate repair.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

MAINTAINABILITY III

Materiel Handlers

Function	Subfunction	Abbreviation	Page
Perform Preventive Maintenance	Perform Routine Servicing	Serv	A-97
Perform Preventive Maintenance	Inspect/Checkout	Insp	A-98
Perform Preventive Maintenance	Replenish/Resupply	Replen	A-99
Perform Corrective Maintenance	Detect/Isolate Faults	Det	A-100
Perform Corrective Maintenance	Prepare for Repair	Prep	A-101
Perform Corrective Maintenance	Repair	Repr	A-102

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY III
Item Class	Materiel Handlers
Function	Perform Preventive Maintenance
Subfunction	Perform Routine Servicing
Abbreviation	Serv

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N/A	Comment
1. Clean components.				
2. Tighten components.				
3. Adjust components.				
4. Align components.				
5. Calibrate components.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY III
Item Class	Materiel Handlers
Function	Perform Preventive Maintenance
Subfunction	Inspect/Checkout
Abbreviation	Insp

Soldier/Item Tasks	YES	NO	N/A	Comment
6. Conduct walk around inspection.				
7. Conduct static checkout.				
8. Conduct dynamic checkout.				
9. Verify readiness.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY III
Item Class	Materiel Handlers
Function	Perform Preventive Maintenance
Subfunction	Replenish/Resupply
Abbreviation	Replen

Soldier/Item Tasks	YES	NO	N / A	Comment
10. Remove and replace.				
11. Attach lines and hoses.				
12. Refill.				
13. Charge.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY III
Item Class	Materiel Handlers
Function	Perform Corrective Maintenance
Subfunction	Detect/Isolate Faults
Abbreviation	Det

Soldier/Item Tasks	YES	NO	N / A	Comment
14. Identify failure.				
15. Identify affected system.				
16. Identify component.				
17. Identify faulty part.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY III
Item Class	Materiel Handlers
Function	Perform Corrective Maintenance
Subfunction	Prepare for Repair
Abbreviation	Prep

Soldier/Item Tasks	YES	NO	N/A	Comment
18. Configure system.				
19. Configure component.				
20. Configure part.				
21. Select tools.				
22. Configure support systems.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY III
Item Class	Materiel Handlers
Function	Perform Corrective Maintenance
Subfunction	Repair
Abbreviation	Repr

Soldier/Item Tasks	YES	NO	N/A	Comment
23. Perform electrical repair.				
24. Perform mechanical repair.				
25. Perform hydraulic repair.				
26. Verify repair. (See Inspect/Checkout.)				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

MAINTAINABILITY IV

Electronics/Signals

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY IV
Item Class	Electronics/Signals
Function	Perform Preventive Maintenance
Subfunction	Service
Abbreviation	Serv

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N / A	Comment
1. Access components.				
2. Tighten components.				
3. Clean components.				
4. Align components.				
5. Adjust components.				
6. Calibrate components.				
7. Remove components.				
8. Replace components.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY IV
Item Class	Electronics/Signals
Function	Perform Preventive Maintenance
Subfunction	Inspect/Checkout
Abbreviation	Insp

Soldier/Item Tasks	YES	NO	N/A	Comment
9. Acquire checklist.				
10. Access components.				
11. Adjust controls.				
12. Read displays.				
13. Read labels.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY IV
Item Class	Electronics/Signals
Function	Perform Corrective Maintenance
Subfunction	Troubleshoot
Abbreviation	Trouble

Soldier/Item Tasks	YES	NO	N/A	Comment
14. Activate controls.				
15. Acquire performance aids.				
16. Read displays.				
17. Access test points.				
18. Activate test equipment.				
19. Read signals.				
20. Make decisions.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY IV
Item Class	Electronics/Signals
Function	Perform Corrective Maintenance
Subfunction	Repair/Replace
Abbreviation	Repr

Soldier/Item Tasks	YES	NO	N/A	Comment
21. Identify component.				
22. Break connections.				
23. Remove component.				
24. Repair component.				
25. Align component.				
26. Replace component.				
27. Make connection.				
28. Verify connection.				
29. Remove and replace module.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY IV
Item Class	Electronics/Signals
Function	Perform Corrective Maintenance
Subfunction	Test/Calibrate
Abbreviation	Cal

Soldier/Item Tasks	YES	NO	N/A	Comment
30. Acquire job performance aids.				
31. Prepare test equipment.				
32. Mate component with test equipment.				
33. Control inputs.				
34. Read outputs.				
35. Check calibration charts.				
36. Verify repair. (See Inspect/Checkout.)				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

MAINTAINABILITY V

Operational Support

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY V
Item Class	Operational Support
Function	Perform Preventive Maintenance
Subfunction	Inspect/Checkout
Abbreviation	Insp

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N/A	Comment
1. Inspect structural components.				
2. Check tightness of fasteners and connectors.				
3. Determine status of expendable materiels.				
4. Determine condition and expected life of line replaceable parts.				
5. Verify operational status of displays.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY V
Item Class	Operational Support
Function	Perform Preventive Maintenance
Subfunction	Perform Routine PM
Abbreviation	Rout

Soldier/Item Tasks	YES	NO	N/A	Comment
6. Clean and paint.				
7. Add preservatives.				
8. Remove and replace minor items (lightbulbs, filters, etc.).				
9. Lubricate.				
10. Add expendables.				
11. Tighten fasteners and connectors.				
12. Adjust, calibrate, and align components.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY V
Item Class	Operational Support
Function	Perform Non-Scheduled Maintenance
Subfunction	Detect Malfunction
Abbreviation	Det

Soldier/Item Tasks	YES	NO	N/A	Comment
13. Monitor displays.				
14. Utilize visual and auditory cues.				
15. Detect changes in system operation.				
16. Read malfunctioning indicator.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY V
Item Class	Operational Support
Function	Perform Non-Scheduled Maintenance
Subfunction	Isolate/Identify Causes
Abbreviation	Isol

Soldier/Item Tasks	YES	NO	N / A	Comment
17. Visually inspect components.				
18. Read built-in test meters.				
19. Apply troubleshooting strategy.				
20. Apply auxiliary test equipment to test points.				
21. Obtain readouts.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY V
Item Class	Operational Support
Function	Remove/Replace
Subfunction	Remove Malfunctioning Component
Abbreviation	Remv

Soldier/Item Tasks	YES	NO	N/A	Comment
22. Open and secure accesses.				
23. Remove fasteners and connectors.				
24. Lift, pull, slide, or push components off of or out of item.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	MAINTAINABILITY V
Item Class	Operational Support
Function	Remove/Replace
Subfunction	Replacement/Repair on Item
Abbreviation	Repr

Soldier/Item Tasks	YES	NO	N/A	Comment
25. Place and hold component in position.				
26. Apply and tighten fasteners and connectors.				
27. Attach cables, hoses, and wires.				
28. Verify adequacy of replacement.				
29. Repair component while mounted on item.				
30. Recalibrate and realign.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

TRANSPORTABILITY

Function	Subfunction	Abbreviation	Page
Prepare for Transport	Place in Transit Configuration	Config	A-117
Prepare for Transport	Package	Pack	A-118
Load/Unload	Load onto Carrier	Load	A-119
Secure/Unfasten	Immobilize Item	Immob	A-120
Secure/Unfasten	Prepare for Use	Prep	A-121

TASK CHECKLIST

Test Function - Checklist	TRANSPORTABILITY
Function	Prepare for Transport
Subfunction	Place in Transit Configuration
Abbreviation	Config

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N / A	Comment
1. Position and lock movable components.				
2. Remove and secure loose and projecting components.				
3. Apply protective covering.				
4. Remove expendable liquids.				
5. Connect or remove auxiliary equipment (fording or winterizing kits).				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	TRANSPORTABILITY
Function	Prepare for Transport
Subfunction	Package
Abbreviation	Pack

Soldier/Item Tasks	YES	NO	N/A	Comment
6. Disassemble item elements.				
7. Obtain or construct package.				
8. Insert item into package.				
9. Insert shock proofing materiel.				
10. Anchor item.				
11. Close package.				
12. Apply labeling.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	TRANSPORTABILITY
Function	Load/Unload
Subfunction	Load onto Carrier
Abbreviation	Load

Soldier/Item Tasks	YES	NO	N/A	Comment
13. Attach or remove hooks and cables to or from lifting points on item or package.				
14. Engage item with materiel handling components (forks).				
15. Place item on or in pallets, cargo nets, slings, or other lifting and loading devices.				
16. Attach item where required - lifting, sliding, or rolling item to do so.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	TRANSPORTABILITY
Function	Secure/Unfasten
Subfunction	Immobilize Item
Abbreviation	Immob

Soldier/Item Tasks	YES	NO	N/A	Comment
17. Secure ties to item.				
18. Secure ties to carrier.				
19. Increase or decrease tension of ties during or after initial task.				
20. Check out tie-downs during transit to verify connection and tension.				
21. Check wheels; lock tracks.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	TRANSPORTABILITY
Function	Secure/Unfasten
Subfunction	Prepare for Use
Abbreviation	Prep

Soldier/Item Tasks	YES	NO	N/A	Comment
22. Open package.				
23. Remove item or components.				
24. Assemble item.				
25. Clean, lubricate, etc.				
26. Install, set up, and distribute item.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

PORTABILITY/USABILITY

Function	Subfunction	Abbreviation	Page
Carry/Wear Item	Don/Doff	Don	A-123
Carry/Wear Item	Wear	Wr	A-124
Carry/Wear Item	Carry Item	Car	A-125
Carry/Wear Item	Perform Combat Functions	Comb	A-126
Utilize Item	Prepare for Use	Prep	A-127
Utilize Item	Use	Us	A-128

TASK CHECKLIST

Test Function - Checklist	PORTABILITY/USABILITY
Function	Carry/Wear Item
Subfunction	Don/Doff
Abbreviation	Don

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N/A	Comment
1. Put on or take off shirt, gloves, boots, trousers, and protective clothing.				
2. Button, snap, and tie clothing.				
3. Attach or emplace load into or onto pack, load carrier, or carrying case.				
4. Buckle straps, snap catches, or otherwise attach portable gear to body, cartridge belt, or pack harness.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	PORTABILITY/USABILITY
Function	Carry/Wear Item
Subfunction	Wear
Abbreviation	W r

Soldier/Item Tasks	YES	NO	N / A	Comment
5. Wear clothing.				
6. Wear personal equipment items (backpack, cartridge belt, etc.).				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	PORTABILITY/USABILITY
Function	Carry/Wear Item
Subfunction	Carry Item
Abbreviation	Car

Soldier/Item Tasks	YES	NO	N/A	Comment
7. Carry item on back or body (no hands).				
8. Adjust carrying elements (straps and holders).				
9. Carry item in one or both hands.				
10. Carry item by one or more soldiers.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	PORTABILITY/USABILITY
Function	Carry/Wear Item
Subfunction	Perform Combat Functions
Abbreviation	Comb

Soldier/Item Tasks	YES	NO	N / A	Comment
11. Fasten item securely to body to prevent flapping or interference.				
12. Discard item in emergency (snagged on vegetation or barbed wire).				
13. Disconnect or raise item for wading if wetting is a problem.				
14. Carry item while performing various combat tasks.				
15. Eliminate noise sources caused by or relative to the item.				
16. Cover or modify visible or reflecting surfaces to ensure camouflage.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	PORTABILITY/USABILITY
Function	Utilize Item
Subfunction	Prepare for Use
Abbreviation	Prep

Soldier/Item Tasks	YES	NO	N/A	Comment
17. Open access flaps or covers.				
18. Remove item from case.				
19. Connect components.				
20. Extend and fasten collapsible and folding components.				
21. Manipulate adjustment controls.				
22. Verify operational status.				
23. Clean and adjust optics.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	PORTABILITY/USABILITY
Function	Utilize Item
Subfunction	Use
Abbreviation	Us

Soldier/Item Tasks	YES	NO	N/A	Comment
24. Put on and adjust item (goggles, life preserver, etc.).				
25. Use item as designed (dig, illuminate, etc.).				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

ERECTABILITY

Function	Subfunction	Abbreviation	Page
Prepare	Layout/Inspect	Insp	A-130
Assemble	Perform Subassembly	Sub	A-131
Assemble	Perform Major Assembly	Assem	A-132
Verify Construction	Final Inspection	Fin	A-133

TASK CHECKLIST

Test Function - Checklist	ERECTABILITY
Function	Propare
Subfunction	Layout/Inspect
Abbreviation	Insp

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N/A	Comment
1. Unpackage or uncover components.				
2. Move components into proper relationship to each other according to S.O.P. or technical instructions.				
3. Check out structural integrity of components as well as status of moving or sliding parts.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	ERECTABILITY
Function	Assemble
Subfunction	Perform Subassembly
Abbreviation	Sub

Soldier/Item Tasks	YES	NO	N/A	Comment
4. Prepare connecting points (clean, abrade, apply adhesive, etc.).				
5. Join structural elements.				
6. Insert and tighten fasteners and connectors.				
7. Align structural elements.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	ERECTABILITY
Function	Assemble
Subfunction	Perform Major Assembly
Abbreviation	Assem

Soldier/Item Tasks	YES	NO	N / A	Comment
8. Raise or move subassembly to connection point.				
9. Climb or stand on parts of item, ladders, scaffolding, or watercraft.				
10. Manipulate subassembly into proper position.				
11. Mate and fasten components.				
12. Insert gaskets.				
13. Connect cables, hoses, guywires, and other elements as required.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	ERECTABILITY
Function	Verify Construction
Subfunction	Final Inspection
Abbreviation	Fin

Soldier/Item Tasks	YES	NO	N/A	Comment
14. Conduct "engineering" type test (strain, leakage, bearing strength, etc.).				
15. Drive or place maximum load on item.				
16. Visually inspect subassembly placement and connection.				
17. Manually determine status of fasteners and connectors.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

HABITABILITY

TASK CHECKLIST

Test Function - Checklist	HABITABILITY
Function	Translate/Transport
Subfunction	Move About
Abbreviation	Mov

Test Title	
Test Project No.	Date

Soldier/Item Tasks	YES	NO	N/A	Comment
1. Move through hallways				
2. Climb ladders.				
3. Move through doors and hatches.				
4. Identify location.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	HABITABILITY
Function	Translate/Transport
Subfunction	Transport Materiel
Abbreviation	Trans

Soldier/Item Tasks	YES	NO	N/A	Comment
5. Carry loads.				
6. Move loads using transport aid.				
7. Move loads to and from storage.				
8. Secure or unsecure loads.				
9. Monitor loads during transport.				
10. Read labels and warnings.				
11. Avoid obstacles.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	HABITABILITY
Function	Perform On-Duty Activities
Subfunction	Work
Abbreviation	Work

Soldier/Item Tasks	YES	NO	N/A	Comment
12. Take position.				
13. Stow or unstow equipment.				
14. Inspect station.				
15. Communicate.				
16. Move about the building.				
17. Occupy workspace.				
18. Control workspace environment.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	HABITABILITY
Function	Perform Off-Duty Activities
Subfunction	Perform Rest and Relaxation
Abbreviation	R&R

Soldier/Item Tasks	YES	NO	N / A	Comment
19. Prepare area.				
20. Stow or unstow equipment.				
21. Control environment.				
22. Sleep or rest.				
23. Perform solitary activity.				
24. Perform group activity.				

YES = Adequate NO = Inadequate N/A = Not Applicable

TASK CHECKLIST

Test Function - Checklist	HABITABILITY
Function	Perform Off-Duty Activities
Subfunction	Perform Living Activities
Abbreviation	Liv

Soldier/Item Tasks	YES	NO	N/A	Comment
25. Stow or unstow items.				
26. Perform self care.				
27. Perform medical care.				
28. Perform dental care.				
29. Perform eating.				
30. Perform waste elimination.				
31. Modify area decor.				

YES = Adequate NO = Inadequate N/A = Not Applicable

APPENDIX B

SAMPLE DESIGN CHECKLISTS

This appendix presents a series of sample Design Checklists covering the twenty-two Item Component categories listed in Figure 3 of HEDGE. These checklists should not be used verbatim. Inappropriate items should be deleted and appropriate items should be added in order to achieve a complete checklist. In the Design Checklists, MIL-STD-1472D design requirements are documented using paragraph references. Other checklist items are to be considered as guidance data (MIL-HDBK-759, etc.).

DESIGN CHECKLIST

1. LABELS, MANUALS & MARKINGS

DESIGN CHECKLIST

Components	LABELS, MANUALS & MARKINGS
HF Considerations	Functionality
Abbreviation	Function

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N/A	Comment
1. Controls, displays, and other items of equipment are clearly marked and labeled except in cases where use is obvious to the operator. (5.5.1.1)				
2. Equipment subassemblies and parts are clearly labeled. (5.5.6.1.1)				
3. Load capacity is marked on lifting equipment. (5.13.2.3)				
4. Lubrication points are labeled to show frequency and type of lubricant. (5.9.5.2)				
5. Where fasteners must be torqued, a label is provided showing torque values and tightening sequence. (5.9.10.8)				
6. Where appropriate, the center of gravity and weight of equipment is provided on a label. (5.13.2.2)				
7. Hand grasp areas on equipment are conspicuously labeled.(5.13.2.7)				
8. Control labeling is functionally based and includes calibration data where applicable. (5.5.6.2.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LABELS, MANUALS & MARKINGS
HF Considerations	Functionality (Cont.)
Abbreviation	Function

Detailed Design Considerations	YES	NO	N/A	Comment
9. Trademarks and company names or other similar markings not related to panel or component function do not appear on labeling. (5.2.1.3.8, 5.5.3.3)				
10. Labels are concise with a minimum of repetitive information. (5.5.4.1)				
11. Abstract symbols are used only if meaningful. (5.5.4.2)				
12. Labels are constructed to remain legible for the life of the equipment. (5.5.4.5)				
13 Labels on production equipment are as durable as the equipment. (5.5.1.3)				
14. Labels for prototype equipment are easily affixed, altered, and removed. (5.5.1.3)				
15. Markings and tags are as permanent as the equipment to which applied and able to withstand environmental and cleaning conditions. (5.5.4.5)				
16. Computer data groups or messages have the content designated by a title, word or similar device. (5.15.3.1.10)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LABELS, MANUALS & MARKINGS
HF Considerations	Functionality (Cont.)
Abbreviation	Function

Detailed Design Considerations	YES	NO	N / A	Comment
17. The relationship of the computer data label to the group, field, or message being described is unambiguous. (5.15.3.1.10)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LABELS, MANUALS & MARKINGS
HF Considerations	Location & Arrangement
Abbreviation	Loc

Detailed Design Considerations	YES	NO	N/A	Comment
18. Labels are placed on or near the item to be identified. (5.5.2.2)				
19. Labels do not cover any other information and are not located behind controls. They can be seen easily by the operator and are not obscured by the operator's hand activating a control. (5.5.2.2)				
20. Labels are located in a consistent manner throughout the equipment and system. (5.5.2.3)				
21. Labels are not covered by other equipment and are located on the flattest, least cluttered, and cleanest surface available. (5.5.6.1.2)				
22. Labels are mounted so that they cannot be accidentally damaged or removed. (5.5.6.1.2)				
23. Where instructions are lettered on hinged door, lettering is set so that it can be read when the door is open. (5.9.9.3)				
24. Computer data labels are located in a consistent fashion adjacent to the data group or message they describe. (5.15.3.1.10)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LABELS, MANUALS & MARKINGS
HF Considerations	Size & Shape
Abbreviation	Size

Detailed Design Considerations	YES	NO	N/A	Comment
25. Labels are graduated in size. Group label characters are at least 25% larger than those of individual controls and displays. (5.5.6.2.5)				
26. Control and display characters, in turn, are at least 25% larger than those identifying control positions. (5.5.6.2.5)				
27. Character height is determined by reading distance and luminance in accordance with Table XII in MIL-STD-1472D. (5.5.5.14, 5.5.5.15)				
28. Letter and numeral styles are in accordance with HEDGE FIGURES C-1 to C-3. (5.5.5.3)				
29. Character width:height ratio is 3:5 except: "4" is 1 stroke width wider. "M" & "W" = 4:5. "I" and "1" are 1 stroke width. (5.5.5.5, 5.5.5.6)				
30. Stroke width for black characters on light background is: 1/7 of character height min., 1/6 of character height max. (5.5.5.8)				
31. Where dark adaptation or nighttime legibility is required and white characters are used on a black background, the stroke width is: 1/8 of character height min., 1/7 of character height max. (5.5.5.9)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LABELS, MANUALS & MARKINGS
HF Considerations	Size & Shape (Cont.)
Abbreviation	Size

Detailed Design Considerations	YES	NO	N/A	Comment
32. For transilluminated characters, the stroke width is 1/10 of the character height. (5.5.5.10)				
33. Spacing between characters is a minimum of one stroke. (5.5.5.11)				
34. Spacing between words is a minimum of one character. (5.5.5.12)				
35. Line spacing is a minimum of 1/2 the character height.(5.5.5.13)				
36. Numerals on counters have separation of 1/4 to 1/2 of character width.(5.2.6.2.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LABELS, MANUALS & MARKINGS
HF Considerations	Visibility & Identification
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N/A	Comment
37. Labels are accessible and visible during maintenance. (5.9.4.3)				
38. Vertical labels are used only when the labels are not critical for personal safety and performance and space is limited. (5.5.2.1)				
39. Signs are all capitals except for instructional material. (5.5.5.4.4)				
40. Extended copy (instructions) is in lower case letters. (5.5.5.4.4)				
41. Abbreviations are capital letters, periods being omitted except when there is a possibility of misinterpretation. (5.5.3.2)				
42. Label characteristics are consistent with the following: a) Accuracy of identification required. b) Time available for response. c) Reading distance. d) Illuminant level and color. e) Criticality of function. f) Consistency of label design within and between systems. (5.5.1.2)				
43. Labels are easily read at operational reading distances with vibration/motion and lighting levels taken into consideration. (5.5.4.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LABELS, MANUALS & MARKINGS
HF Considerations	Visibility & Identification (Cont.)
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N/A	Comment
44. Label color provides contrast with equipment. (5.5.4.6)				
45. Where dark adaptation is required, white characters on a dark background are used. (5.5.5.2)				
46. With illumination above .9 ft-c (10 lux), black letters on a light background are used. (5.5.5.1)				
47. For dark adaptation, characters are visible and do not interfere with night vision. (5.5.5.2)				
48. When letters, etc., are viewed by means of television, they are light against a dark background. (5 10.4.6)				
49. Numerals are Arabic rather than Roman. (5.15.3.5.6.4)				
50. Optical projections: Characters are all caps. Stroke width is 1/6 to 1/8 of character height. Width subtends at least 15 arcmin. (4 mrad) of visual angle.				
51. Where chart reading is required, materials conform to requirements of Table XXII of MIL-STD-1472D.				
52. Functional groupings of components are set apart by outlining with contrasting lines which completely encompass the groups. (5.1.2.1.1.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	**LABELS, MANUALS & MARKINGS**
HF Considerations	**Visibility & Identification (Cont.)**
Abbreviation	**Vis**

Detailed Design Considerations	YES	NO	N/A	Comment
53. Noncritical functional groupings of components are outlined with a 1/16 in. (1.5 mm) black border. (5.1.2.1.1.3)				
54. Emergency or extremely critical components are outlined with a 3/16 in (5 mm) red border. (5.1.2.1.1.3)				
55. Computer data labels are highlighted or otherwise accentuated. (5.15.3.1.10)				
56. The technique used to accentuate computer data labels is different from, and easily distinguished from, that used to highlight or code emergency or critical messages. (5.15.3.1.10)				
57. Computer data labels are unique and meaningful. (5.15.3.1.10)				
58. Computer data labels are displayed in upper case only. (5.15.3.1.10)				
59. Abbreviations, mnemonics, or codes used in computer data labels are distinctive and have an association to normal language or job-related terminology. (5.15.2.1.9)				

YES = Adequate **NO = Inadequate** **N/A = Not Applicable**

DESIGN CHECKLIST

Components	LABELS, MANUALS & MARKINGS
HF Considerations	Safety
Abbreviation	Safety

Detailed Design Considerations	YES	NO	N/A	Comment
60. Equipment which presents personnel hazards has a conspicuous warning placard. (5.13.2.1)				
61. Where protective equipment is necessary, this is specified by a warning placard. (5.13.2.4)				
62. "NO STEP" warning labels are provided where personnel injury or equipment damage could result. (5.13.2.5)				
63. Electrical receptacles are clearly marked with voltage, phase, and frequency characteristics. (5.13.2.6)				
64. Pipe, hose, and tube lines are clearly labeled as to contents, pressure, temperature, and hazards. (5.13.3)				
65. Warning placards are well illuminated. (5.13.4.5)				
66. Warning notices are clear and direct. Characters are 25% larger than any following instructions. (5.9.9.3)				
67. Placards are placed adjacent to hazards. (5.13.2.1)				
68. Circuit breakers are labeled and easily accessible. (5.9.17.2.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LABELS, MANUALS & MARKINGS
HF Considerations	Safety (Cont.)
Abbreviation	Safety

Detailed Design Considerations	YES	NO	N/A	Comment
69. Items which weigh more than the one-person lifting limits given in paragraph 5.9.11.3.1 are prominently labeled with the object weight and lifting limitations. (5.9.11.3.9)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LABELS, MANUALS & MARKINGS
HF Considerations	Operating Procedures
Abbreviation	Op

Detailed Design Considerations	YES	NO	N/A	Comment
70. Printed information is directly usable with a minimum of decoding and interpolation. (5.2.1.3.3)				
71. Labels do not describe the engineering characteristics or nomenclature of the piece of equipment, if at all possible. (5.5.3.1)				
72. Abbreviations are standard and conform to MIL-STD-12, MIL-STD-411 or MIL-STD-783. New abbreviations have obvious meaning.				
73. Instructional material in excess of several lines may use upper and lower case characters. For brief instructional material all capitals are preferred with a larger first letter of each paragraph, step, or procedure permitted. (5.5.5.4.3)				
74. Axes of graphs are labeled. (5.15.3.6.4)				
75. Linear scales are used for graphs. (5.2.3.1.4)				
76. Scale graduations progress by 1,2 or 5 units or decimal multiples of these. (5.2.3.1.5.1)				
77. The number of minor or intermediate marks between numerical scale pointers is nine or less. (5.2.3.1.5.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LABELS, MANUALS & MARKINGS
HF Considerations	Operating Procedures (Cont.)
Abbreviation	Op

Detailed Design Considerations	YES	NO	N / A	Comment
78. Scale numerals are integers starting at zero unless this is precluded by the nature of the measurement or function. (5.2.3.1.6)				
79. Aircraft advisory, caution and warning legends conform to the requirements of MIL-STD-411.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

2. STEPS, LADDERS, PLATFORMS, HANDHOLDS & RAILINGS

DESIGN CHECKLIST

Components	STEPS, LADDERS, PLATFORMS, HANDHOLDS & RAILINGS
HF Considerations	Functionality
Abbreviation	Function

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N/A	Comment
1. Adequate footholds are provided for crew to reach work site from ground. (5.14.3.2)				
2. Handholds are provided for emergency evacuation. (5.14.4.1.7)				
3. Stair ladders are metal with the tread open at the rear. (5.7.7.3)				
4. Stairs, ladders, platforms, and ramps are designed to withstand heaviest combined weight of user plus equipment plus safety factor.				
5. Stairs, stair-ladders, fixed ladders and ramps are equipped with a handrail on each side. (5.7.7.1.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	STEPS, LADDERS, PLATFORMS, HANDHOLDS & RAILINGS
HF Considerations	Location & Arrangement
Abbreviation	Loc

Detailed Design Considerations	YES	NO	N/A	Comment
6. Sequence of stepping points ends with proper orientation to door or entryways.				
7. Where a ramp is used for both pedestrian and vehicle traffic, the vehicle surface is in the center of the ramp and the pedestrian surface is next to the handrails. (5.7.7.5.2)				
8. Step surfaces within or without workspace are easily reached from either direction.				
9. Fixed ladders between several levels are offset at each succeeding level. (5.7.7.4)				
10. Simultaneous two-way traffic uses separate up/down ladders.				
11. Handholds are furnished where needed and are within easy reach. (5.14.3.2)				
12. Handholds are integrated with doors and entryways for stability.				
13. Handholds do not intrude into workspace, snag clothing or provide a safety hazard. (5.7.1.2)				
14. Stairs and steps are not used where loads in excess of 29 lb. (13 kg) is required. (5.7.7.1.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	STEPS, LADDERS, PLATFORMS, HANDHOLDS & RAILINGS
HF Considerations	Location & Arrangement (Cont.)
Abbreviation	Loc

Detailed Design Considerations	YES	NO	N/A	Comment
15. Trailer vans or other shelters with floors over 18 in. (45.72 cm) above ground have steps, stairs, or ladders. (5.12.7.2)				
16. Use of stairs, stair-ladders, fixed ladders and ramps conforms to FIGURE 33 in MIL-STD-1472D. (5.7.7.1.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	STEPS, LADDERS, PLATFORMS, HANDHOLDS & RAILINGS
HF Considerations	Size & Shape
Abbreviation	Size

Detailed Design Considerations	YES	NO	N/A	Comment
17. Stair dimensions conform to FIGURE 34 in MIL-STD-1472D. (5.7.7.2)				
18. Stair-ladder dimensions conform to FIGURE 35 in MIL-STD-1472D. (5.7.7.3)				
19. Fixed ladder dimensions conform to FIGURE 36 in MIL-STD-1472D. (5.7.7.4)				
20. Where cleats are provided on pedestrian ramps, spacing between cleats is 14 in. (360 mm). (5.7.7.5.1)				
21. Gross (limiting) dimensions based on 5th & 95th percentile body dimensions of users are conformed to as expressed in TABLES XIII to XVII in MIL-STD-1472D.				
22. Stair, stair-ladder, fixed ladder dimensions do not exceed the maximum dimensions given in FIGURES 34 to 36 in MIL-STD-1472D.				
23. Platform to work surface distance is 6 in. (15.24 cm) max.				
24. Platforms are 2 ft. x 3 ft. (.61 m x .91 m) min.				
25. Handrail dimensions are consistent with FIGURES 34 to 36 in MIL-STD-1472D.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	STEPS, LADDERS, PLATFORMS, HANDHOLDS & RAILINGS
HF Considerations	Size & Shape (Cont.)
Abbreviation	Size

Detailed Design Considerations	YES	NO	N / A	Comment
26. Handhold length is a minimum of 6 in.(15.24 cm).				
27. Handhold opening has minimum dimensions of 6 in. x 4 in. (15.24 cm x 10.21 cm).				
28. Handholds are shaped to provide a suitable grip.				
29. Folding ladder lift height is 5 ft. (1.5 m) maximum.				
30. Finger clearance is provided in folding steps and telescoping ladders. (5.13.7.2.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	STEPS, LADDERS, PLATFORMS, HANDHOLDS & RAILINGS
HF Considerations	Visibility & Identification
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N/A	Comment
31. Stairway illumination level is. 20 ft-c.(215 lux) recommended, 10 ft-c (110 lux) min. (5.13.4.5)				
32. Visual obstructions or blind footholds are avoided. (5.13.4.4)				
33. Treads contrast with structure and are conspicuous in dim light.				
34. For reduced lighting, reflective materials are used.				
35. Handholds are coded to enhance visibility and prevent grasping error.				
36. Handholds are marked and identified. (5.13.2.7)				
37. Footholds are marked and identified. (5.7.8.3)				
38. "No Step" markings are provided if applicable. (5.13.2.5)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	STEPS, LADDERS, PLATFORMS, HANDHOLDS & RAILINGS
HF Considerations	Use Conditions
Abbreviation	Use

Detailed Design Considerations	YES	NO	N/A	Comment
39. Handholds accommodate use of arctic mittens as prescribed in FIGURE 2-12 in MIL-HDBK-759A (MI).				
40. Stairs, ladders & platforms accommodate 5th to 95th percentile users wearing arctic clothing per TABLES 2-9 and 2-10 in MIL-HDBK-759A (MI).				
41. Step width and spacing accommodate user wearing boots per TABLE 2-9 in MIL-HDBK-759A (MI).				
42. Folding ladder latches, locks are operable while wearing arctic mittens per FIGURE 2-12 in MIL-HDBK-759A(MI).				
43. Handholds are useable with gloves or arctic mittens. (5.14.4.1.7)				
44. Steps are usable if wet or icy.				
45. Rung ladders are not used for frequent passage.				
46. Two-section extension ladders have captive hardware.				
47. Wheeled platforms have wheel locks.				
48. Access is provided between areas.				
49. Stairs and ladders accommodate 5th-95th percentile user wearing arctic clothing.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	STEPS, LADDERS, PLATFORMS, HANDHOLDS & RAILINGS
HF Considerations	Use Conditions (Cont.)
Abbreviation	Use

Detailed Design Considerations	YES	NO	N/A	Comment
50. Handholds are usable if wet or icy.				
51. Handgrip is usable with bare hands in hot climates and high temperature. (5.9.11.5.7)				
52. Collapsible handholds are erectable while wearing arctic mittens. (5.9.11.5.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	STEPS, LADDERS, PLATFORMS, HANDHOLDS & RAILINGS
HF Considerations	Safety
Abbreviation	Safety

Detailed Design Considerations	YES	NO	N / A	Comment
53. Stairs, stair-ladders, and ramps with handrails which open on one or both sides have intermediate guardrails. (5.7.7.1.3)				
54. Exterior personnel platforms and work areas have open metal grating or nonskid surface. (5.7.7.6)				
55. Open sides of personnel platforms have: a) Guardrails with intermediate rails. b) A top rail with height of 42 in. (1.07 m) minimum. c) Rails set back from edge 2 1/2 in. (65 mm) minimum. d) Toeboard or guard screen with height of 3 in. (75 mm) min. (5.7.7.6)				
56. Stairs, ladders, hand-rails have a nonslip surface. (5.7.7.3)				
57. Handrails, safety bars, or chains around platforms or stair openings are placed 42 in. (1.067 m) above standing surface. (5.7.7.6, 5.13.6.2)				
58. Where personnel movement is required inside a vehicle in motion, adequate handholds are provided and are 36 in. (915 mm) above the walking surface. (5.14.3.5.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	STEPS, LADDERS, PLATFORMS, HANDHOLDS & RAILINGS
HF Considerations	Safety (Cont.)
Abbreviation	Safety

Detailed Design Considerations	YES	NO	N/A	Comment
59. Self-locking devices are used on elevating stands and platforms. (5.13.6.1)				
60. Ladders are not provided when equipment is to be hand carried. (5.7.7.1.2)				
61. Fixed ladders over 20 ft. (6 m) in height are equipped with a device to provide protection from falls. (5.7.7.4)				
62. Safety mesh is installed under open gratings. (5.13.6.3)				
63. Ladders and stairs have a nonslip surface. (5.13.4.3)				
64. Step openings have safety bars or chains. (5.13.6.2)				
65. Obstructions and sharp edges are padded.				
66. Ladders are located away from moving parts and electrical sources and other hazards. (5.13.5.2)				
67. Movable ladders have non-slip feet.				
68. There are no obstructions or projections on stairs or ladders to snag bulky clothing.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	STEPS, LADDERS, PLATFORMS, HANDHOLDS & RAILINGS
HF Considerations	Safety (Cont.)
Abbreviation	Safety

Detailed Design Considerations	YES	NO	N/A	Comment
69. Portable ladder conforms to lifting limits for one soldier: Up to 3 ft. (.92 m) 87 lb. (39.5 kg) max. Up to 5 ft. (1.53 m) 56 lb. (25.4 kg) max. (5.9.11.3.1)				
70. Inappropriate structures or wires cannot be used as hand holds. (5.9.13.6)				
71. Railings have no projections or snags.				
72. Elevators, inclinators, and hydraulic work platforms, when provided, have: a) Maximum load signs. b) Lift control guards. c) Limit stops. d) Automatic fail-safe brake. e) Provision for manually lowering platform or elevator. f) Metal grating or nonskid surface.				
73. Warning labels are attached for hazards. (5.13.2.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	STEPS, LADDERS, PLATFORMS, HANDHOLDS & RAILINGS
HF Considerations	Operating Procedures
Abbreviation	Op

Detailed Design Considerations	YES	NO	N/A	Comment
74. Ladders are carried, positioned, or handled by 2 soldiers maximum.				
75. Procedures are available for stowing, placing ladders, ramps, platforms.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

3. DOORS, HATCHES & PASSAGES

DESIGN CHECKLIST

Components	DOORS, HATCHES & PASSAGES
HF Considerations	Functionality
Abbreviation	Function

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N/A	Comment
1. Wall hatches are flush with the floor wherever structurally possible. (5.7.8.2.1)				
2. Hatches open with a single motion of hand or foot. (5.7.8.2.1)				
3. Sliding doors are not installed as the only personnel exit. (5.7.8.1)				
4. Doors are designed to minimize jamming. (5.14.3.4.1)				
5. Suitable handholds are provided where necessary. (5.14.3.2)				
6. Suitable footholds are provided where necessary. (5.14.3.2)				
7. Latch handle placement is uniform throughout the test item. (5.14.3.4.2)				
8. Doors and hatches are quick opening, easily operated, and have standard latch handle operation throughout. (5.14.4.2.3)				
9. Overhead hatches are padded inside and equipped for hand operation.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DOORS, HATCHES & PASSAGES
HF Considerations	Size & Shape, Location & Arrangement
Abbreviation	Size

Detailed Design Considerations	YES	NO	N/A	Comment
10. Clearance dimensions for passageways and accesses are based on the 95th percentile values for applicable body dimensions from TABLES XIII - XVIII in MIL-STD-1472D. (5.6.3.2)				
11. Fixed equipment is located 3 in. (75 mm) minimum from swept area of doors. (5.7.8.1)				
12. Dimensions of rectangular hatch conform to requirements of FIGURE 37 in MIL-STD-1472D as follows: a) Light clothing: <u>Top and bottom access</u>: Depth: 13 in. (33 cm) min. Width: 23 in. (58 cm) min. <u>Side access</u>: Depth: 26 in. (66 cm) min. Width: 30 in. (76 cm) min. b) Bulky clothing: <u>Top and bottom access</u>: Depth: 16 in. (41 cm) min. Width: 27 in. (69 cm) min. <u>Side access</u>: Depth: 29 in. (74 cm) min. Width: 34 in. (86 cm) min. (5.7.8.2.3, 5.7.8.3)				
13. Minimum diameters for oval hatch in armored vehicle are 17, 28 in. (43, 71 cm). (5.7.8.3				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DOORS, HATCHES & PASSAGES
HF Considerations	Size & Shape, Location & Arrangement (Cont.)
Abbreviation	Size

Detailed Design Considerations	YES	NO	N/A	Comment
14. If "step down" through a top access exceeds 27 in. (69 cm), appropriate footrests and steps are provided. (5.7.8.3)				
15. Minimum diameter for circular hatch or tunnel is 30 in. (76 cm). (5.7.8.3, 5.14.3.3.1)				
16. Tunnel dimensions permit the passage of the user with equipment and clothing. (5.14.3.3.2)				
17. Corridor width is based on peak load, traffic flows and number and size of entrances per FIGURE 2-27 in MIL-HDBK-759A(MI).				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DOORS, HATCHES & PASSAGES
HF Considerations	Direction & Force
Abbreviation	Dir

Detailed Design Considerations	YES	NO	N / A	Comment
18. The maximum hatch handle unlocking force is 20 lb. (90 N). (5.7.8.2.2)				
19. Overhead hatch has maximum opening force of 50 lb. (220 N) and is operable by a suitably equipped and clothed user with 5th percentile arm and hand strength per FIGURE 21 in MIL-STD-1472D. (5.7.8.2.2)				
20. Emergency exit release handle requires maximum force of 25 lb. (110 N) in the lateral direction and 45 lb. (200 N) maximum pull force. (5.14.4.2.4)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DOORS, HATCHES & PASSAGES
HF Considerations	Visibility & Identification
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N / A	Comment
21. Passageway illumination level is: 20 ft-c. (215 lux) recommended, 10 ft-c. (110 lux) min (5.8.2)				
22 Exits are identifiable in dim light. (5.14.3.1.1)				
23. Clear visual indication of latch handle position is provided. (5.10.1.4)				
24. Emergency lights: a) Are located at each exit. b) Have self-contained power. c) Are automatic. d) Are removable for emergencies. (5.14.4.2.1)				
25. Correct movement of latch handle is diagrammed and labeled. (5.14.3.4.2)				
26. Hallway boundaries are clearly marked.				
27. Door jamb or coaming height allows full view of step point.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DOORS, HATCHES & PASSAGES
HF Considerations	Use Conditions
Abbreviation	Use

Detailed Design Considerations	YES	NO	N/A	Comment
28. Handles and handgrips are usable with arctic mitts. (5.9.11.55)				
29. Handles can be reached and operated by troops in bulky clothing.				
30. Entry and egress is possible while wearing vapor barrier boots.				
31. Windows intended for viewing (as opposed to those providing general illumination) do not ice up.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	**DOORS, HATCHES & PASSAGES**
HF Considerations	**Safety**
Abbreviation	**Safety**

Detailed Design Considerations	YES	NO	N/A	Comment
32. Exit instructions are legible, brief and clearly worded. (5.14.3.1.1)				
33. Passage floors are non-slip. (5.14.3.6)				
34. Emergency evacuation of all persons can be completed within 60 seconds, using only one-half of the exits. (5.14.4.1.2)				
35. Doors and emergency exits are easily reached, unobstructed and quick-opening (3 sec. maximum). (5.14.4.1.2)				
36. Hatches over 72 in. (1.83 m) above ground have evacuation aids such as slides, poles, ladders and ropes. (5.14.4.1.6)				
37. Ropes, as evacuation aids, stand off from structure to permit use by more than one person at a time. (5.14.4.1.6)				
38. Escape openings are smooth edged, have no obstructions and permit passage with survival equipment. (5.14.4.2.2)				
39. Escape exits do not open inadvertently (5.14.4.2.5)				
40. Escape exit handles a[illegible] not lock-wired. (5.14.4.2.5)				
41. Corridors have non-skid floors.				

YES = Adequate **NO = Inadequate** **N/A = Not Applicable**

DESIGN CHECKLIST

Components	DOORS, HATCHES & PASSAGES
HF Considerations	Safety (Cont.)
Abbreviation	Safety

Detailed Design Considerations	YES	NO	N/A	Comment
42. Glass in doors is shatterproof.				
43. No hazards or obstructions are found in entryways or on either side.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

4. EXTERNAL COMPONENTS

DESIGN CHECKLIST

Components	EXTERNAL COMPONENTS
HF Considerations	Functionality
Abbreviation	Function

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N/A	Comment
1. Trucks have glare-proof, west coast type and spotter mirrors on each side of the cab. (5.12.5.5)				
2. Winch and vehicle power trains are capable of simultaneous operation. (5.12.9.4.2)				
3. Winch controls are operable from cab as well as from winch. (5.12.9.4.4)				
4. Windshield wiper blades return to stored position when turned off. (5.12.5.8)				
5. Windshield wipers and washer are provided. (5.12.5.8)				
6. Windshield wipers can be operated manually if power fails. (5.12.5.8)				
7. Combat vehicle fuel tanks with capacity over 50 gal. can be refueled at 50 gal./min. (189.25 l/min.)				
8. Fuel tanks with capacity under 50 gal. (189.25 l) can be filled within one minute.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	EXTERNAL COMPONENTS
HF Considerations	Functionality (Cont.)
Abbreviation	Function

Detailed Design Considerations	YES	NO	N/A	Comment
9. Compressed air. vacuum brake reservoir has warning system.				
10. Mirrors are braced against vibration.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	EXTERNAL COMPONENTS
HF Considerations	Location & Arrangement, Size & Shape
Abbreviation	Loc

Detailed Design Considerations	YES	NO	N/A	Comment
11. Components requiring adjustment are readily accessible. (5.12.9.1.3)				
12. Drain valves are minimum in number, readily accessible, reliable, hand-operated. (5.12.9.1.1)				
13. Munition tie-down facilities are easily installed/removed. (5.12.7.1.3)				
14. Trailer brake controls are within reach when positioning trailer manually and are not exposed to traffic. (5.12.7.1.1)				
15. Fuel fillpipe is located outside cab or body.				
16. Drain plugs and valves are same size, or number of sizes is minimized. (5.12.9.1.1)				
17. Battery terminals are of different sizes and polarity is marked. (5.12.9.1.4)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	EXTERNAL COMPONENTS
HF Considerations	Clearance & Separation
Abbreviation	Clear

Detailed Design Considerations	YES	NO	N/A	Comment
18. Dual wheels allow inner and outer tires to be checked/inflated. (5.12.9.2.1)				
19. Spare tire is easily removed and replaced in carrier with vehicle fully loaded. (5.12.9.2.2)				
20. Spare tire can be checked and inflated when stowed. (5.12.9.2.2)				
21. Hinged access covers open down.				

YES = Adequate NO = inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	EXTERNAL COMPONENTS
HF Considerations	Visibility & identification
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N/A	Comment
22. Electrical connections are labeled. (5.13.2.6)				
23. Filters are accessible for inspection. (5.12.9.1.2)				
24. Fuel, oil, coolant and hydraulic fill points are labeled as to type/grade. (5.13.3)				
25. Pipes, lines, hoses and dip sticks are color-coded and labeled. (5.13.3)				
26. Timing marks and other indicators minimize parallax and are readily visible. (5.12.9.1.3)				
27. Tire pressure is labeled. (5.13.3)				
28. Winch instruction is visible. (5.12.9.4.1)				
29. Winch operation is observable from both winch and cab locations. (5.12.9.4.4)				
30. Fuel tank capacity is labeled.				
31. Airbrake and hydraulic hoses are identifiable at each end.				
32. Components which must be visible are color-coded and contrast with background.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	**EXTERNAL COMPONENTS**
HF Considerations	**Use Conditions**
Abbreviation	**Use**

Detailed Design Considerations	YES	NO	N/A	Comment
33. Components can be handled, removed, installed using artic mitts. (5.9.11.5.5)				
34. Battery compartment has space for heating pads and insulation used to winterize vehicle.				
35. Components are within reach of user wearing bulky or restrictive clothing.				
36. Small parts handled with arctic mitts are captive.				
37. Special handling, assembly and operating procedures and precautions for cold weather are provided.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	EXTERNAL COMPONENTS
HF Considerations	Safety
Abbreviation	Safety

Detailed Design Considerations	YES	NO	N/A	Comment
38. Weight capacity is indicated on stands, lifts, hoists and jacks. (5.13.2.3)				
39. Battery compartment is well ventilated.				
40. Bus exhaust pipe extends beyond rear of vehicle body.				
41. Exhaust system is located and protected so user cannot contact hot surfaces.				
42. Fuel tank and lines are not within vehicle body.				
43. Safety chains do not damage or disconnect air lines, hydraulic lines or electrical cables.				
44. Two separate ways to apply brakes are provided.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	EXTERNAL COMPONENTS
HF Considerations	Operating Procedures
Abbreviation	Op

Detailed Design Considerations	YES	NO	N / A	Comment
45. Special tools for operational adjustment are mounted nearby. (5.9.1.2)				
46. Winch cable is easily played out by one soldier. (5.12.9.4.3)				
47. Battery can be removed by one soldier.				
48. Jacking operation is feasible.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

5. CONTROLS

DESIGN CHECKLIST

Components	CONTROLS
HF Considerations	Functionality
Abbreviation	Function

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N/A	Comment
1. Control motion is minimized, not cycled through ON/OFF unnecessarily. (5.4.1.3.1)				
2. Critical and sensitive adjustment controls are located or guarded to prevent accidental activation. (5.9.3.5, 5.4.1.8.1)				
3. If there is a possibility of inadvertent activation causing a hazardous condition, controls are recessed or shielded by a physical barrier. (5.4.1.8.4)				
4. Resistance is built-in so that definite or sustained effort is required for activation. (5.4.1.8.4)				
5. "Dead-man" controls are used when operator incapacity can produce a critical condition. (5.4.1.8.5)				
6. Controls are usable in the time required despite protection against inadvertent operation (guards). (5.4.1.8.3)				
7. All controls have appropriate scales or indexing. (5.2.3, 5.5.6.2.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONTROLS
HF Considerations	Functionality (Cont.)
Abbreviation	Function

Detailed Design Considerations	YES	NO	N/A	Comment
8. The time lag between the response of a system to a control input and the display presentation of the response is minimized. (5.1.3.2)				
9. When a knob is provided for making coarse display element settings on linear scales, having 0.016 to 0.100 in. (0.4 to 2.5 mm) of tolerance, approximately 6 in. (150 mm) of display element movement is provided for one complete turn of the knob. (5.1.4.3)				
10. For fine setting on linear scales having 0.008 to 0.016 in. (0.2 to 0.4 mm) of tolerance, the display element movement for one rotation of the knob is: 1 in. (25 mm) min., 2 in. (50 mm) max. (5.1.4.4)				
11. When bracketing is used to locate a maximum or minimum rather than a specific value (e.g., as in tuning a transmitter), the control knob swings through an arc of: 10° (175 mrad) min., 30° (525 mrad) max. (5.1.4.5)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONTROLS
HF Considerations	Functionality (Cont.)
Abbreviation	Function

Detailed Design Considerations	YES	NO	N/A	Comment
12. When a lever is provided for coarse settings, having 0.016 to 0.100 in. (0.4 to 2.5 mm) of tolerance, one unit of display element movement is used to three units of lever movement. (5.1.4.6)				
13. When a lever is provided to make settings in two dimensions to coarse tolerances on the order of 0.1 in. (2.5 mm), one unit of display element movement is used to two and one-half units of lever movement. (5.1.4.7)				
14. When counters are provided, the control-display ratio is such that one revolution of the knob produces approximately 50 counts (i.e., the right hand drum rotates 5 times). (5.1.4.8)				
15. Controls are not adversely affected by distortion, shock, and vibration. (5.12.3.1)				
16. Failure of power steering does not incapacitate steering. (5.12.3.2)				
17. Adjustment controls are easy to set and lock.				
18. Critical controls are designed and located so that they are not susceptible to being moved accidentally.				
19. The main power ON/OFF switch cuts all power to the equipment.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONTROLS
HF Considerations	Location & Arrangement
Abbreviation	Loc

Detailed Design Considerations	YES	NO	N / A	Comment
20. Controls are located adjacent to their associated displays. (5.1.1.1)				
21. Functionally related controls and displays are grouped together. (5.1.2.1)				
22. Controls in functional groups are located in accordance with operational sequence and/or function. (5.4.1.3.1)				
23. Control groups used for sequential operations have left-to-right or top-to-bottom order of use. (5.4.1.3.2)				
24. Controls most often used are located in the best position for ease of reaching and grasping. (5.4.1.3.3)				
25. Groups with similar functions are similarly arranged throughout the system. (5.4.1.3.4)				
26. Control/display groups used only for maintenance are not located in prime operating space. (5.4.1.3.6)				
27. Lifting equipment controls are within easy reach with the load visible. (5.12.8.3)				
28. Controls operated without visual reference are located in front of rather than to the side of or behind the operator. (5.4.1.2.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONTROLS
HF Considerations	Location & Arrangement (Cont.)
Abbreviation	Loc

Detailed Design Considerations	YES	NO	N / A	Comment
29. Internally mounted controls are located away from dangerous voltage heat, moving parts, radiation or other hazards. (5.13.5.2)				
30. Emergency controls are located close to related warning displays or nearest available hand in normal operating position. (5.1.2.3.8)				
31. Controls are located adjacent to their associated displays (preferably under or to the right of the displays). (5.1.1.1)				
32. Controls are positioned such that neither the control nor the operator's hand obscures the display. (5.1.1.1)				
33. Controls are located so that they cannot be moved accidentally. (5.4.1.8.1)				
34. When control operation requires reading several displays, the control is located beneath and in the middle of the display group. (5.1.2.3.4)				
35. When separate displays are affected by a combined control, the control is located beneath and in the middle of the display group. (5.1.2.3.5)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONTROLS
HF Considerations	Location & Arrangement (Cont.)
Abbreviation	Loc

Detailed Design Considerations	YES	NO	N/A	Comment
36. Controls are selected and distributed so that none of the operator's limbs are overburdened. (5.4.1.1.1)				
37. Mirror image arrangements are not used. (5.1.2.1.1.4)				
38. When related controls and displays must be located on separate panels and both panels are mounted at approximately the same angle relative to the operator, the control positions on one panel correspond to the associated display positions on the other panel. The two panels are not mounted facing each other. (5.1.2.3.6)				
39. When a group of equipment components has the same function, the related control and display positions are oriented to correspond to those of the controlled and monitored components. (5.1.2.3.7)				
40. For standing operations, controls requiring precise or frequent operation and emergency controls are mounted as follows: Height above standing surface: 34 in. (860 mm) min., 53 in. (1.35 m) max. Lateral distance from centerline: 21 in. (530 mm) max. (5.7.2.5)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONTROLS
HF Considerations	Location & Arrangement (Cont.)
Abbreviation	Loc

Detailed Design Considerations	YES	NO	N/A	Comment
41. Range of control action does not interfere with other controls. (5.4.1.3.7)				
42. For seated operations, controls mounted on a vertical surface and used in normal equipment operation are located at a height above the sitting surface of: 8 in. (200 mm) min., 34 in. (860 mm) max. (5.7.3.9)				
43. For seated operations, controls mounted on a vertical surface and requiring precise or frequent operation are located at a height above the sitting surface of: 8 in. (200 mm) min., 29 in. (740 mm) max. (5.7.3.10)				

YES = Adequate NO = inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONTROLS
HF Considerations	Size & Shape
Abbreviation	Size

Detailed Design Considerations	YES	NO	N / A	Comment
44. Controls used for the same function on different types of equipment are of the same size and shape. (5.4.1.4.3, 5.4.1.4.4)				
45. Controls that are shape-coded are free of sharp edges. (5.4.2.1.2.3)				
46. A maximum of 3 sizes are used for coding; 2 sizes for key operated switches. (5.4.1.4.3, 5.4.2.1.2.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONTROLS
HF Considerations	Direction & Force
Abbreviation	Dir

Detailed Design Considerations	YES	NO	N/A	Comment
47. When circular, fixed-pointer or moving-scale indicators are used, clockwise movement of a rotary control or movement of a linear control forward, up, or to the right, produce a counterclockwise movement of the scale and an increase in the magnitude of the reading. (5.1.3.5)				
48. Controls are selected so that the direction of movement of the control will be consistent with the related movement of an associated display, equipment component, or vehicle. (5.1.3.8)				
49. Direction-of-movement relationships are adhered to when control and display are parallel in line of movement. (5.1.3.9)				
50. Rotary controls turn to the right (clockwise) to increase, and left (counterclockwise) to decrease. (5.4.1.2.1)				
51. Rotary valve controls open counterclockwise. (5.4.1.2.4)				
52. Remote controls are designed for direction-of-movement consistency. (5.4.1.3.5)				
53. Control movement conforms with corresponding related display. (5.4.1.2.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONTROLS
HF Considerations	Direction & Force (Cont.)
Abbreviation	Dir

Detailed Design Considerations	YES	NO	N/A	Comment
54. Stops are provided at the beginning and end of the control travel. (5.4.1.1.5)				
55. Controls meant to have a limited degree of motion have adequate mechanical stops. (5.9.3.4)				
56. Selector switches have sufficient spring loading to keep from stopping between detents.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONTROLS
HF Considerations	Visibility & Identification
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N/A	Comment
57. Controls are labeled with basic information for proper identification, utilization, actuation, or manipulation of the elements. (5.5.6.2.1)				
58. Controls are labeled as to function and method of operation by means of arrows and appropriate legends. (5.5.6.2.3)				
59. Coding is uniform throughout the system. (5.4.1.4.1)				
60. Shape-coded controls are visually and tactually identifiable. (5.4.1.4.4)				
61. Controls are black or gray unless color coded. (5.4.1.4.5.1)				
62. Color coded controls are red, green, orange-yellow or white. (5.4.1.4.5.1)				
63. Control color has high contrast with background. (5.4.1.4.5.4)				
64. Ambient light color determines usable control colors. (5.4.1.4.5.5)				
65. If red lighting is used, red is not used for coding. Black and yellow striping is used instead. (5.4.1.4.5.5)				
66. Main power switch is labeled.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONTROLS
HF Considerations	Operating Procedures (Cont.)
Abbreviation	Op

Detailed Design Considerations	YES	NO	N/A	Comment
67. Operating instructions are provided except where use is obvious. (5.12.4.1)				
68. Diagrams are used wherever possible. (5.12.4.2)				
69. Calibration instructions are placed as close to the calibrating control as possible. (5.2.3.1.9)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	ROTARY SELECTOR SWITCHES
HF Considerations	Functionality, Location & Arrangement
Abbreviation	Rot Sel

Detailed Design Considerations	YES	NO	N/A	Comment
70. Rotary selector switches which are not visible to the operator during normal system operation have no more than 12 positions. (5.4.2.1.1.4)				
71. Rotary selector switches that are constantly visible to the operator have no more than 24 positions. (5.4.2.1.1.4)				
72. A reference line is provided on rotary switch controls which has at least 3.0 luminance contrast. (5.4.2.1.1.5)				
73. Rotary selector switches are not placed opposite one another unless it is obvious which end is the pointer. (5.4.2.1.1.4)				
74. Knob pointers are mounted sufficiently close to the scale so that parallax errors do not exceed 25% of the distance between scale markings. (5.4.2.1.1.6)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	ROTARY SELECTOR SWITCHES
HF Considerations	Size & Shape
Abbreviation	Rot Sel

Detailed Design Considerations	YES	NO	N/A	Comment
75. DIMENSIONS: Length 1.0 in. (25 mm) min., 4.0 in. (100 mm) max. Width 1.0 in. (25 mm) min. Depth 0.625 in. (16 mm) min., 3.0 in. (75 mm) max. See FIGURE 4 in MIL-STD-1472D. (5.4.2.1.1.7)				
76. DISPLACEMENT: Large separation or tactually positioned 30°(525 mrad) min., 90°(1570 mrad) max. For facilitating performance 15° (262 mrad) min., 40° (700 mrad) max. See FIGURE 4 in MIL-STD-1472D. (5.4.2.1.1.7)				
77. Rotary selector switches are bar shaped with parallel sides and the index end tapering to a point (except when shape coding is required or when space is restricted and torque is light). (5.4.2.1.1.3)				
78. Rotary controls are shape coded when a group of similar type but different function is placed on the same panel and control confusion might exist. (5.4.2.1.1.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	ROTARY SELECTOR SWITCHES
HF Considerations	Direction & Force, Clearance & Separation
Abbreviation	Rot Sel

Detailed Design Considerations	YES	NO	N/A	Comment
79. RESISTANCE: 1.0 in.-lb. (113 mN-m) min., 6.0 in.-lb. (678 mN-m) max. See FIGURE 4 in MIL-STD-1472D. (5.4.2.1.1.7)				
80. SEPARATION: <u>One-Hand Random</u> 1.0 in. (25 mm) min., 2.0 in. (50 mm) preferred. <u>Two-Hand Operation</u> 3.0 in. (75 mm) min., 5.0 in. (125 mm) preferred. See FIGURE 4 in MIL-STD-1472D. (5.4.2.1.1.7)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	KEY OPERATED SWITCHES
HF Considerations	Size & Shape, Direction & Force, Visibility & Identification
Abbreviation	Key Op

Detailed Design Considerations	YES	NO	N/A	Comment
81. HEIGHT: 0.5 in. (13 mm) min., 3.0 in. (75 mm) max. See FIGURE 5 in MIL-STD-1472D. (5.4.2.1.2.2)				
82. DISPLACEMENT: 30°(525 mrad) min., 90° (1570 mrad) max See FIGURE 5 in MIL-STD-1472D. (5.4.2.1.2.2)				
83. RESISTANCE: 1 in.-lb (115 mN-m) min., 6 in.-lb (680 mN-m) max. See FIGURE 5 in MIL-STD-1472D. (5.4.2.1.2.2)				
84. Key-operated switches use color coding or are identified by use location if adequate illumination exists. (5.4.2.1.2.3)				
85. Red (#11105 or 21105 of FED-STD-595) is reserved for emergency functions. (5.4.2.1.2.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DISCRETE THUMBWHEELS
HF Considerations	Functionality, Size & Shape
Abbreviation	Disc Thumb

Detailed Design Considerations	YES	NO	N/A	Comment
86. Use is restricted to applications where a compact control device and a readout for verification of manual entry are required. (5.4.2.1.3.1)				
87. Discrete thumbwheel controls provide 10 detent positions (0-9) in digital or binary (3 or 4 bits and complement) outputs. (5.4.2.1.3.1)				
88. DIMENSIONS: Diameter 1.125 in. (30 mm) min., 3 in. (75 mm) max. Trough Distance 0.45 in. (11 mm) min., 0.75 in. (19 mm) max. Width 0.1 in. (3 mm) min. Depth 0.125 in. (3 mm) min., 0.5 in. (13 mm) max. See FIGURE 6 in MIL-STD-1472D. (5.4.2.1.3.7)				
89. Each position formed by detents has a concave surface or is separated by a raised high-friction area. (5.4.2.1.3.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DISCRETE THUMBWHEELS
HF Considerations	Direction & Force, Clearance & Separation
Abbreviation	Disc Thumb

Detailed Design Considerations	YES	NO	N/A	Comment
90. RESISTANCE: 6 oz. (170 mN) min., 20 oz. (560 mN) max. See FIGURE 6 in MIL-STD-1472D. (5.4.2.1.3.7)				
91. SEPARATION: 0.4 in. (10 mm) min. See FIGURE 6 in MIL-STD-1472D. (5.4.2.1.3.7)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DISCRETE THUMBWHEELS
HF Considerations	Visibility & Identification
Abbreviation	Disc Thumb

Detailed Design Considerations	YES	NO	N/A	Comment
92. For areas in which ambient illumination will provide display brightness below 1 ft-L (3.5 cd/sq m), thumbwheels are internally illuminated. (5.4.2.1.3.5.1)				
93. For areas in which ambient illumination will provide display brightness below 1 ft-L (3.5 cd/sq m), digits appear as illuminated characters on a black background. (5.4.2.1.3.5.1)				
94. For areas in which ambient illumination will provide display brightness above 1 ft-L (3.5 cd/sq m), digits appear as black characters on a light background. (5.4.2.1.3.5.2)				
95. Thumbwheel numerals: a) Height:width ratio = 3:2. b) Height is a minimum of 3/16 in. (4.8 mm). c) Stroke width for internally illuminated numerals = 1/10 of height. d) Stroke width for externally illuminated numerals = 1/5 of height. (5.4.2.1.3.5.1, 5.4.2.1.3.5.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONTINUOUS ROTARY KNOBS
HF Considerations	Location & Arrangement, Size & Shape
Abbreviation	Cont Knob

Detailed Design Considerations	YES	NO	N/A	Comment
96. In right-hand operations, knobs are placed below or to the right of displays. (5.1.1.1)				
97. For left-hand operations, knobs are placed below or to the left of displays. (5.1.1.1)				
98. If knob diameter is used to code controls, minimum differences between diameters are .5 in. (13 mm). (5.4.1.4.3)				
99. When bracketing is used, control knob swings through an arc of: 10° (175 mrad) min., 30° (525 mrad) max. (5.1.4.5)				
100. If thickness is used for coding, minimum differences between thicknesses are 0.4 in. (10 mm). (5.4.1.4.3)				
101. Shape coding: a) Does not interfere with ease of control manipulation. b) Is identifiable regardless of control position and orientation. c) Is tactually identifiable when gloves are worn. d) Is associated with or resembles control function. (5.4.1.4.4)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONTINUOUS ROTARY KNOBS
HF Considerations	Size & Shape (Cont.)
Abbreviation	Cont Knob

Detailed Design Considerations	YES	NO	N / A	Comment
102. Shape-coded knobs and handles are attached to shafts to preclude incorrect attachment. (5.4.1.4.4)				
103. Continuous adjustment rotary knobs have serrated edges, fine serrations for precise adjustment knobs, and coarse serrations for gross adjustment knobs. (5.4.2.2.2.3)				
104. DIMENSIONS: Fingertip Grasp Height 0.5 in. (13 mm) min., 1.0 in. (25 mm) max. Diameter 0.375 in. (10 mm) min., 4.0 in. (100 mm) max. Thumb and Finger Encircled Diameter 1.0 in. (25 mm) min., 3.0 in. (75 mm) max. Palm Grasp Diameter 1.5 in. (38 mm) min., 3.0 in. (75 mm) max. Palm Grasp Length 3.0 in. (75 mm) min. See FIGURE 7 in MIL-STD-1472D. (5.4.2.2.1.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONTINUOUS ROTARY KNOBS
HF Considerations	Direction & Force, Clearance & Separation
Abbreviation	Cont Knob

Detailed Design Considerations	YES	NO	N/A	Comment
105. TORQUE: <u>Diameter up to 1.0 in. (25mm)</u> 4.5 in.-oz. (32 mN-m) max. <u>Diameter greater than 1.0 in. (25mm)</u> 6.0 in.-oz. (42 mN-m) max. See FIGURE 7 in MIL-STD-1472D. (5.4.2.2.1.2)				
106. SEPARATION: <u>One Hand Individually</u> 1.0 in. (25 mm) min., 2.0 in. (50 mm) max. <u>Two Hands Simultaneously</u> 2.0 in. (50 mm) min., 5.0 in. (125 mm) max. See FIGURE 7 in MIL-STD-1472D. (5.4.2.2.1.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	GANGED ROTARY KNOBS
HF Considerations	Functionality
Abbreviation	Gang Knob

Detailed Design Considerations	YES	NO	N / A	Comment
107. For ganged knobs 3 knobs is the maximum, 2 knobs is preferred. (5.4.2.2.2)				
108. Ganged knobs are not used: a) If accuracy and time is critical. b) When controls are frequently used. c) When heavy gloves are worn. d) When equipment is exposed to the weather. e) When equipment is used in the field. (5.4.2.2.2.1)				
109. Clearly differentiated indexing marks or pointers are provided for each knob in ganged set. (5.4.2.2.2.4)				
110. Ganged knob assemblies have a secondary knob control movement such as pressing while turning to prevent inadvertent operation. (5.4.2.2.2.6)				
111. For ganged knob assemblies, the knob closest to the panel is associated with the left most display in a horizontal array, or the uppermost in a vertical array. (5.4.2.2.2.5)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	GANGED ROTARY KNOBS
HF Considerations	Size & Shape
Abbreviation	Gang Knob

Detailed Design Considerations	YES	NO	N / A	Comment
112. DIMENSIONS: a) Two-knob assembly <u>Height 1st knob</u> 5/8 in. (16 mm) min. <u>Height 2nd knob</u> 1/2 in. (13 mm) min. <u>Diameter 1st knob</u> 1/2 in. (13 mm) min. <u>Diameter 2nd knob</u> 7/8 in. (22 mm) min., 4 in. (100 mm) max. b) Three-knob assembly <u>Height 1st knob</u> 3/4 in. (19 mm) min. <u>Height 2nd knob</u> 3/4 in. (19 mm) min. <u>Height 3rd knob</u> 1/4 in. (6 mm) min. <u>Diameter 1st knob</u> 1/2 in. (13 mm) min. <u>Diameter 2nd knob</u> 1 3/4 in. (44 mm) min. <u>Diameter 3rd knob</u> 3 in. (75 mm) min., 4 in. (100 mm) max. See FIGURE 8 in MIL-STD-1472D. (5.4.2.2.2.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	GANGED ROTARY KNOBS
HF Considerations	Direction & Force, Clearance & Separation
Abbreviation	Gang Knob

Detailed Design Considerations	YES	NO	N/A	Comment
113. TORQUE: Up to and including 1 in. (25 mm) diameter knobs 4 1/2 in.-oz. (32 mN-m) max. Greater than 1 in. (25 mm) diameter knobs 6 in.-oz. (42 mN-m) max. See FIGURE 8 in MIL-STD-1472D. (5.4.2.2.2.2)				
114. SEPARATION: One-hand operation with glove 2 1/2 in. (63 mm) min., 3 1/2 in. (90 mm) optimum. One-hand operation without glove 1 in. (25 mm) min., 2 in. (50 mm) optimum. Two hand operation with glove 3 1/2 in. (90 mm) min., 4 in. (100 mm) optimum Two-hand operation without glove 2 in. (50 mm) min., 3 in. (75 mm) optimum. See FIGURE 8 in MIL-STD-1472D. (5.4.2.2.2.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONTINUOUS ADJUSTMENT THUMBWHEELS
HF Considerations	Functionality, Size & Shape
Abbreviation	Cont Thumb

Detailed Design Considerations	YES	NO	N/A	Comment
115. Usage is restricted to applications requiring a compact continuous control device. (5.4.2.2.3.1)				
116. Rims are serrated and detents provided for OFF positions. (5.4.2.2.3.3)				
117. DIMENSIONS: Rim exposure length 1 in. (25 mm) min., 4 in. (100 mm) max. Width 1/8 in. (3 mm) min., 7/8 in. (23 mm) max. See FIGURE 9 in MIL-STD-1472D. (5.4.2.2.3.4)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONTINUOUS ADJUSTMENT THUMBWHEELS
HF Considerations	Direction & Force, Clearance & Separation
Abbreviation	Cont Thumb

Detailed Design Considerations	YES	NO	N / A	Comment
118. RESISTANCE: min: To minimize effects of inadvertent input if operator subject to motion max: 12 oz. (3.3 N) See FIGURE 9 in MIL-STD-1472D. (5.4.2.2.3.4)				
119. Thumbwheel orientation and movement direction conforms to FIGURE 9 in MIL-STD-1472D. (5.4.2.2.3.2)				
120. For manipulation of vehicle motion, movement of thumbwheel upward causes the vehicle to move forward. (5.4.2.2.3.2)				
121. SEPARATION: <u>Controls, side by side with gloves</u>: 1 1/2 in. (38 mm) min. <u>Controls, side by side without gloves</u>: 1 in. (25 mm) min. <u>Controls, end to end with gloves</u>: 3 in. (75 mm) min. <u>Controls, end to end without gloves</u>: 2 in. (50 mm) min. See FIGURE 9 in MIL-STD-1472D. (5.4.2.2.3.4)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CRANKS
HF Considerations	Functionality
Abbreviation	Crank

Detailed Design Considerations	YES	NO	N/A	Comment
122. Cranks are used for tasks requiring many control rotations and when rotation rate or forces are excessive. (5.4.2.2.4.1)				
123. Dual cranks are used for tasks requiring the setting of reticles or crosshairs in map reading or optical sighting. (5.4.2.2.4.1)				
124. Folding handle cranks are used when appropriate to protect persons from injury, or to prevent inadvertent actuation. (5.4.2.2.4.4)				
125. Folding handles are spring loaded. (5.4.2.2.4.4)				
126. Where resistance is light, cranks are balanced to prevent motion from last setting. (5.4.2.2.4.5)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CRANKS
HF Considerations	Size & Shape
Abbreviation	Crank

Detailed Design Considerations	YES	NO	N/A	Comment
127. DIMENSIONS: a) Diameter Light loads, less than 5 lb. (22 N) hand movement 3/8 in. (10 mm) min., 5/8 in. (16 mm) max., 1/2 in. (13 mm) preferred. Heavy loads, more than 5 lb. (22 N) arm movements 1 in. (25 mm) min., 1 1/2 in. (38 mm) max., 1 in. (25 mm) preferred. b) Length Light loads 1 in. (25 mm) min., 3 in. (75 mm) max., 1 1/2 in. (38mm) preferred. Heavy loads 3 in. (75 mm) min. 3-3/4 in. (95 mm) preferred. See FIGURE 10 in MIL-STD-1472D. (5.4.2.2.4.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CRANKS
HF Considerations	**Size & Shape, Clearance & Separation**
Abbreviation	Crank

Detailed Design Considerations	YES	NO	N/A	Comment
128. TURNING RADIUS: a) Rate below 100 RPM Light loads 1 1/2 in. (38 mm) min., 5 in. (125 mm) max., 3 in. (75 mm) preferred. Heavy loads 7 1/2 in. (190 mm) min., 20 in. (510 mm) max. b) Rate above 100 RPM Light loads 1/2 in. (13 mm) min., 4 1/2 in. (115 mm) max., 2 1/2 in. (65 mm) preferred. Heavy loads 5 in. (125 mm) min., 9 in. (230 mm) max. See FIGURE 10 in MIL-STD-1472D. (5.4.2.2.4.3)				
129. SEPARATION: 3 in. (75 mm) min. See FIGURE 10 in MIL-STD-1472D. (5.4.2.2.4.3)				

YES = Adequate **NO = Inadequate** **N/A = Not Applicable**

DESIGN CHECKLIST

Components	HANDWHEELS
HF Considerations	Functionality, Size & Shape
Abbreviation	Hand Wheel

Detailed Design Considerations	YES	NO	N/A	Comment
130. Handwheels are used when rotational forces are too high for one-handed controls (e.g., steering, latch securing, valve regulation, and direct linkage adjustment). (5.4.2.2.5.1)				
131. Maximum turning limit of vehicle is achieved in no more than 3 1/2 turns to meet force standards. (5.4.2.2.5.8)				
132. DIMENSIONS - Diameter: Continuous adjustment 8 in. (200 mm) min., 20 in. (510 mm) max. Continuous lock - unlock operation 8 in. (200 mm) for 5 lb. (22 N) min., 20 in. (510 mm) for 35 lb. (155 N) max. High torque valves overhead 8 in. (200 mm) min., 16 in. (400 mm) max. Other positions 8 in. (200 mm) min., 20 in. (510 mm) max. Above standing surface 12 in. (300 mm) min. 60 in. (1520 mm) max. Vehicle power steering 14 in. (355 mm) min., 16 in. (400 mm) max. Non power (max 50 lb. (220 N)) 16 in. (40 mm) min., 20 in. (510 mm) max. See TABLE IX in MIL-STD-1472D. (5.4.2.2.5.5)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	HANDWHEELS
HF Considerations	Size & Shape
Abbreviation	Hand Wheel

Detailed Design Considerations	YES	NO	N / A	Comment
133. DIMENSIONS - Rim diameter: Continuous adjustment 3/4 in. (19 mm) min., 1 1/4 in. (32 mm) max. Continuous lock - unlock operation 3/4 in. (19 mm) min., 1 1/4 in. (32 mm) max. High torque valves 3/4 in. (19 mm) min., 1 1/4 in. (32 mm) max. Vehicle power steering 3/4 in. (19 mm) min., 1 1/4 in. (32 mm) max. Vehicle steering - non power 3/4 in. (19 mm) min., 1 1/4 in. (32 mm) max. See TABLE IX in MIL-STD-1472D. (5.4.2.2.5.5)				
134. DIMENSIONS - Hand clearance around rim: Continuous adjustment 3 in. (75 mm) min. Continuous lock - unlock operation 3 in. (75 mm) min. High torque valves 3 in. (75 mm) min. See TABLE IX in MIL-STD-1472D. (5.4.2.2.5.5)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	HANDWHEELS
HF Considerations	Size & Shape, Clearance & Separation
Abbreviation	Hand Wheel

Detailed Design Considerations	YES	NO	N/A	Comment
135. DIMENSIONS - Slope: Vehicle power steering (light vehicle) preferred 30° (525 mrad) Vehicle steering - non power (heavy vehicle) preferred 45° (785 mrad) See TABLE IX in MIL-STD-1472D. (5.4.2.2.5.5)				
136. DISPLACEMENT: Where both hands must remain on wheel: ±120° (2/3 rad) max. See TABLE IX in MIL-STD-1472D. (5.4.2.2.5.5)				
137. SEPARATION: Continuous adjustment 28 in. (710 mm) min. Continuous lock - unlock operation 28 in. (710 mm) min. High torque valves 28 in. (710 mm) min. See TABLE IX in MIL-STD-1472D. (5.4.2.2.5.5)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	PUSHBUTTONS (FINGER OR HAND OPERATED)
HF Considerations	Functionality, Size & Shape
Abbreviation	Push Hand

Detailed Design Considerations	YES	NO	N/A	Comment
138. Positive indication in provided of push button activation. (5.4.3.1.1.3)				
139. Channel or cover guard is provided where it is imperative to avoid accidental activation. (5.4.3.1.1.4)				
140. Cover guard in the open position does not interfere with pushbutton operation. (5.4.3.1.1.4)				
141. Mechanical interlocks or barriers are incorporated as an alternative to separation. (5.4.3.1.1.6)				
142. Pushbutton surface is concave or has non-slip surface. (5.4.3.1.1.2)				
143. DIMENSIONS - Diameter: Fingertip Operation 3/8 in. (9.5 mm) min., 1 in. (25 mm) max. Thumb or Heel of Hand Operation 0.75 in. (19 mm) min. See FIGURE 11 in MIL-STD-1472D. (5.4.3.1.1.5)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	PUSHBUTTONS (FINGER OR HAND OPERATED)
HF Considerations	Size & Shape (Cont.)
Abbreviation	Push Hand

Detailed Design Considerations	YES	NO	N/A	Comment
144. DISPLACEMENT: Thumb or Palm Operation 0.125 in. (3 mm) min., 1.5 in. (38 mm) max. Fingertip Operation 5/64 in. (2 mm) min., 1/4 in. (6 mm) max. See FIGURE 11 in MIL-STD-1472D. (5.4.3.1.1.5)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	PUSHBUTTONS (FINGER OR HAND OPERATED)
HF Considerations	Direction & Force, Clearance & Separartion
Abbreviation	Push Hand

Detailed Design Considerations	YES	NO	N/A	Comment
145. RESISTANCE: Single Finger Operation 10 oz. (2.8 N) min., 40 oz. (11.0 N) max. Different Finger operation 5 oz. (1.4 N) min., 20 oz. (5.6 N) max. Thumb or Palm Operation 10 oz. (2.8 N) min., 80 oz. (23 N) max. See FIGURE 11 in MIL-STD-1472D. (5.4.3.1.1.5)				
146. SEPARATION: Single Finger Operation 1/2 in. (13 mm) min., 2 in. (50 mm) preferred Single Finger Sequential Operation 1/4 in. (6 mm) min., 1/2 in. (13 mm) preferred Different Finger Operation 1/4 in. (6 mm) min., 1/2 in. (13 mm) preferred Thumb or Palm Operation 1 in. (25 mm) min., 6 in. (150 mm) preferred. See FIGURE 11 in MIL-STD-1472D. (5.4.3.1.1.5)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	PUSHBUTTONS (FOOT OPERATED)
HF Considerations	Functionality
Abbreviation	Push Foot

Detailed Design Considerations	YES	NO	N / A	Comment
147. Foot operated pushbuttons are used: a) When both operator's hands are busy with other controls. b) To conform to control stereotypes. c) As provision for alternate safety shut-down control. d) For distribution of workload. (5.4.1.8.6.1, 5.4.3.1.2.1)				
148. Foot operated pushbuttons are <u>not</u> used: a) If balance-imposed risks for standing operators exist. b) When selection among many controls is required. c) For critical or frequent control operations. (5.4.1.8.6.2)				
149. Foot operated pushbutton operation does <u>not</u> require: a) Frequent maximum reaching. b) Holding leg or foot in awkward position for extended period of time. c) Frequent operation or extended period of time in a twisted seating position. d) Maximum force application. frequently or for extended period of time. e) Search for one pushbutton among many. (5.4.1.8.6.3)				
150. Positive indication of switch actuation is provided. (5.4.3.1.2.4)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	PUSHBUTTONS (FOOT OPERATED)
HF Considerations	Location & Arrangement, Size & Shape
Abbreviation	Push Foot

Detailed Design Considerations	YES	NO	N/A	Comment
151. Foot operated switch is positioned for operation by the toe or ball of the foot. (5.4.3.1.2.2)				
152. Foot operated switch location allows centering the ball of the foot on the button. (5.4.3.1.2.2)				
153. If switch may become wet, the switchcap surface has friction to prevent slippage.				
154. DIMENSIONS: Diameter 0.50 in. (13 mm) min. See FIGURE 12 in MIL-STD-1472D. (5.4.3.1.2.3)				
155. DISPLACEMENT: Normal Boot Operation 0.50 in. (13 mm) min., 2.5 in. (65 mm) max. Heavy Boot Operation 1.0 in. (25 mm) min., 2.5 in. (65 mm) max. Ankle Flexion Only 1.0 in. (25 mm) min., 2.5 in. (65 mm) max. Total Leg Movement 1.0 in. (25 mm) min., 4.0 in. (100 mm) max. See FIGURE 12 in MIL-STD-1472D. (5.4.3.1.2.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	PUSHBUTTONS (FOOT OPERATED)
HF Considerations	Direction & Force, Clearance & Separation
Abbreviation	Push Foot

Detailed Design Considerations	YES	NO	N/A	Comment
156. RESISTANCE: <u>Foot Will Not Rest on Control</u> 4.0 lb. (18 N) min., 20.0 lb. (90 N) max. <u>Foot Will Rest on Control</u> 10.0 lb. (45 N) min., 20.0 lb. (90 N) max. See FIGURE 12 in MIL-STD-1472D. (5.4.3.1.2.3)				
157. If use of more than one foot operated switch per foot cannot be avoided, switches are placed at least 3 in. (66 mm) apart horizontally and 8 in. (203 mm) apart vertically. (5.4.3.1.2.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	KEYBOARDS
HF Considerations	Functionality
Abbreviation	Keyboard

Detailed Design Considerations	YES	NO	N/A	Comment
158. Arrangement and number of keys is compatible with the predominant type of information to be entered into the system. (5.4.3.1.3.2)				
159. Alphanumeric keyboard design conforms to requirements of MIL-STD-1280. (5.4.3.1.3.2)				
160. Systems with more than one keyboard are standardized. (5.4.3.1.3.5)				
161. Feedback is provided to indicate if intended key was pressed and, if applicable, when the next operation may be initiated. (5.4.3.1.3.6)				
162. Keyed inputs are echoed on the display within 0.2 sec. (5.15.2.2.3)				
163. Length of individual data items is minimized, except extended text. (5.15.2.2.4)				
164. Columnar data is automatically decimal point, left margin, or right margin justified depending on the type of data. (5.15.2.2.5)				
165. Numeric keypad is provided if extensive numerical input is required. (5.15.2.2.6)				
166. Amount of keying required is minimized by using numbered lists and abbreviations. (5.15.2.2.7)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	KEYBOARDS
HF Considerations	Functionality, Size & Shape
Abbreviation	Keyboard

Detailed Design Considerations	YES	NO	N/A	Comment
167. The configuration of a keyboard used to enter solely numeric information is a 3 x 3 + 1 matrix with the zero digit centered on the bottom row. (5.4.3.1.3.2)				
168. DIMENSIONS: Diameter Barehanded 0.385 in. (10 mm) min., 0.75 in. (19 mm) max, 0.5 in. (13 mm) preferred. Arctic Mittens 0.75 in. (19 mm) min., 0.75 in. (19 mm) preferred. See TABLE X in MIL-STD-1472D. (5.4.3.1.3.3)				
169. The slope of nonportable keyboards is 15°-25° (260-435 mrad) from the horizontal. (5.4.3.1.3.4)				
170. DISPLACEMENT: Numeric 0.03 in. (0.8 mm) min., 0.19 in. (4.8 mm) max. Alphanumeric 0.05 in. (1.3 mm) min., 0.25 in. (6.3 mm) max. Dual Function 0.03 in. (0.8 mm) min., 0.19 in. (4.8 mm) max. See TABLE X in MIL-STD-1472D. (5.4.3.1.3.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	KEYBOARDS
HF Considerations	Direction & Force, Clearance & Separation
Abbreviation	Keyboard

Detailed Design Considerations	YES	NO	N / A	Comment
171. RESISTANCE: Numeric 3.5 oz. (1 N) min., 14.0 oz. (4 N) max. Alphanumeric 0.9 oz. (250 mN) min., 5.3 oz. (1.5 N) max. Dual Function 0.9 oz. (250 mN) min., 5.3 oz. (1.5 N) max. See TABLE X in MIL-STD-1472D. (5.4.3.1.3.3)				
172. SEPARATION: Between Adjacent Key Tops 0.25 in. (6.4 mm) min., 0.25 in. (6.4 mm) preferred. See TABLE X in MIL-STD-1472D. (5.4.3.1.3.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	FIXED FUNCTION KEYS
HF Considerations	Functionality
Abbreviation	Fixed Key

Detailed Design Considerations	YES	NO	N/A	Comment
173. Fixed function keys are used for time-critical, error-critical, or frequently used control inputs. (5.15.2.3.1)				
174. Fixed function keys are standard throughout the system. (5.15.2.3.2)				
175. A fixed function key, once assigned a function, is not reassigned a different function for a given user. (5.15.2.3.3)				
176. Fixed function keys are used to control continuously available functions. (5.15.2.3.4)				
177. Lockout of fixed function keys is minimized. (5.15.2.3.4)				
178. Nonactive fixed function keys are replaced with a blank key. (5.15.2.3.5)				
179. Fixed function key function is accomplished with a single actuation. (5.15.2.3.7)				
180. Feedback is provided of system acknowledgement of fixed function key activation. (5.15.2.3.8)				
181. Fixed function key assignments are displayed at all times. (5.15.2.3.9)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	FIXED FUNCTION KEYS
HF Considerations	Location & Arrangement
Abbreviation	Fixed Key

Detailed Design Considerations	YES	NO	N/A	Comment
182. Fixed function keys are logically grouped. (5.15.2.3.6)				
183. Fixed function keys are placed in distinctive locations on the keyboard. (5.15.2.3.6)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	VARIABLE FUNCTION KEYS
HF Considerations	Functionality
Abbreviation	Var Key

Detailed Design Considerations	YES	NO	N/A	Comment
184. Variable function key current status is displayed. (5.15.2.4.2)				
185. Variable function keys with labeled default functions, when reprogrammed or turned off, have a visual warning of inaccessibility of the standard function. (5.15.2.4.3)				
186. Variable function keys are easily relabeled. (5.15.2.4.4)				
187. Variable function keys do not require the use of a shift key for each actuation. (5.15.2.4.5)				
188. Where functions assigned to keys change as a result of user inputs, a control action is provided to readily return the functions assigned to a base-level (or standard) set. (5.15.2.4.6)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	TOGGLE SWITCHES
HF Considerations	Functionality
Abbreviation	Toggle

Detailed Design Considerations	YES	NO	N/A	Comment
189. Guards, lift-to-unlock switches (resistance not to exceed 3 lbs.) or other means are used to prevent accidental activation when critical, dangerous, or hazardous conditions may result. (5.4.3.1.4.2)				
190. Cover guards in the open position do not interfere with control activation. (5.4.3.1.4.2)				
191. Three-position spring-loaded to center-off toggle switches with only one other position are not used if release from the spring-loaded position results in switch travel beyond the OFF position. (5.4.3.1.4.1)				
192. Minimum use is made of 3-position toggle switches and horizontally oriented toggle switches. (5.4.3.1.4.1, 5.4.3.1.4.5)				
193. Positive indication of control activation is provided. (5.4.3.1.4.4)				

YES = Adequate **NO = Inadequate** **N/A = Not Applicable**

DESIGN CHECKLIST

Components	TOGGLE SWITCHES
HF Considerations	Size & Shape
Abbreviation	Toggle

Detailed Design Considerations	YES	NO	N/A	Comment
194. DIMENSIONS: Arm Length (Bare Finger) 0.5 in. (13 mm) min., 2.0 in. (50 mm) max. Arm Length (Gloved Finger) 1.5 in. (38 mm) min., 2.0 in. (50 mm) max. Control Tip 0.125 in. (3 mm) min., 1.0 in. (25 mm) max. See FIGURE 13 in MIL-STD-1472D. (5.4.3.1.4.3)				
195. DISPLACEMENT: 2 Position Switch 30° (525 mrad) min., 80° (1400 mrad) max. 3 Position Switch 17° (295 mrad) min., 45°(700 mrad) max., 25° (435 mrad) desired. See FIGURE 13 in MIL-STD-1472D. (5.4.3.1.4.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	TOGGLE SWITCHES
HF Considerations	Direction & Force, Clearance & Separation
Abbreviation	Toggle

Detailed Design Considerations	YES	NO	N/A	Comment
196. RESISTANCE: Small Switch 10 oz. (2.8 N) min., 16 oz. (4.5 N) max. Large Switch 10 oz. (2.8 N) min., 40 oz. (11 N) max. See FIGURE 13 in MIL-STD-1472D. (5.4.3.1.4.3)				
197. SEPARATION: Single Finger Operation 0.75 in. (19 mm) min., 2.0 in. (50 mm) optimum. Single Finger Operation-Lever Lock Toggle Switch 1.0 in. (25 mm) min., 2.0 in. (50 mm) optimum. Single Finger Sequential Operation 0.5 in. (13 mm) min., 1 in. (25 mm) optimum. Simultaneous Operation by Different Fingers 0.625 in. (16 mm) min., 0.75 in. (19 mm) optimum. See FIGURE 13 in MIL-STD-1472D. (5.4.3.1.4.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LEGEND SWITCHES
HF Considerations	Functionality, Size & Shape
Abbreviation	Legend

Detailed Design Considerations	YES	NO	N / A	Comment
198. Switch provides detent, click or other positive indication of actuation. (5.4.3.1.5.3)				
199. Switch legend is legible with or without internal illumination. (5.4.3.1.5.3)				
200. Legend switch lamps are replaceable from the front of the panel by hand and the legends or covers are keyed to prevent the possibility of interchanging the legend covers. (5.4.3.1.5.3)				
201. DIMENSIONS: 0.75 in. (19 mm) min., 0.625 in. (15 mm) min., where switch is not depressed below panel 1.5 in. (38 mm) max. See FIGURE 14 in MIL-STD-1472D. (5.4.3.1.5.1)				
202. BARRIERS: Barrier Width 0.125 in. (3 mm) min., 0.25 in. (6 mm) max. Barrier Depth 0.88 in. (5 mm) min., 0.25 in. (6 mm) max. See FIGURE 14 in MIL-STD-1472D. (5.4.3.1.5.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LEGEND SWITCHES
HF Considerations	Clearance & Separation, Visibility & Identification
Abbreviation	Legend

Detailed Design Considerations	YES	NO	N / A	Comment
203. DISPLACEMENT: 0.125 in. (3 mm) min., 3/16 in. (5 mm) min. for positive position switch, 0.25 in. (6 mm) max. See FIGURE 14 in MIL-STD-1472D. (5.4.3.1.5.1)				
204. RESISTANCE: 10 oz. (2.8 N) min., 20 oz. (5.6 N) min. for use in moving vehicles, 60 oz. (16.7 N) max. See FIGURE 14 in MIL-STD-1472D. (5.4.3.1.5.1)				
205. Legends appear illuminated on an opaque background with character dimensions as follows: a) Height: 3/16 in. (5 mm). b) Height-to-width ratio: 3:2. c) Height-to-Stroke-Width Ratio: 10:1. (5.4.3.1.6.7)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	**ROCKER SWITCHES**
HF Considerations	**Functionality**
Abbreviation	**Rocker**

Detailed Design Considerations	YES	NO	N/A	Comment
206. Rocker switches are used in place of toggle switches for functions which require two discrete positions where toggle switch protrusion is a problem. (5.4.3.1.6.1)				
207. Three-position rocker switches are used only when other types of controls (rotary, legend switch, etc.) are not feasible, or when rocker switch is the spring loaded type. (5.4.3.1.6.1)				
208. Positive indication of switch activation is provided. (5.4.3.1.6.3)				
209. Rocker switches are lit internally when ambient illumination causes display luminance to be below 1 Ft-L. (3.5 cd/sq m). (5.4.3.1.6.7)				
210. Horizontal orientation is used only when compatibility with the controlled function or equipment location is desirable. (5.4.3.1.6.6)				

YES = Adequate **NO = Inadequate** **N/A = Not Applicable**

DESIGN CHECKLIST

Components	ROCKER SWITCHES
HF Considerations	Size & Shape, Direction & Force, Clearance & Separation
Abbreviation	Rocker

Detailed Design Considerations	YES	NO	N/A	Comment
211. DIMENSIONS: Width 1/4 in. (6 mm) min. Length 1/2 in. (13 mm) min. See FIGURE 15 in MIL-STD-1472D. (5.4.3.1.6.4)				
212. DISPLACEMENT: Height depressed 1/8 in. (3 mm) min. Angle 30° (530 mrad) min. See FIGURE 15 in MIL-STD-1472D. (5.4.3.1.6.4)				
213. RESISTANCE: 10 oz. (280 mN) min., 40 oz. (11 N) max. See FIGURE 15 in MIL-STD-1472D. (5.4.3.1.6.4)				
214. SEPARATION: Bare hand, Center-to-center 3/4 in. (19 mm) min. Gloved hand, Center-to-center 1 1/4 in. (32 mm) min. See FIGURE 15 in MIL-STD-1472D. (5.4.3.1.6.4)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	SLIDE SWITCHES
HF Considerations	Functionality, Size & Shape
Abbreviation	Slide

Detailed Design Considerations	YES	NO	N / A	Comment
215. Resistance increases until switch snaps into position. (5.4.3.1.7.3)				
216. Switch does not stop between positions. (5.4.3.1.7.3)				
217. Channel guards are provided to prevent inadvertent operation. (5.4.3.1.7.2)				
218. Switches are vertically oriented such that activation of upper position turns on system; causes an increase in system function; or causes a forward, clockwise, or upward movement. (5.4.3.1.7.4)				
219. DIMENSIONS: Actuator height with gloves 1/2 in. (13 mm) min. Without gloves 1/4 in. (6 mm) min. Actuator width 1/8 in. (6 mm) min., 1 in. (25 mm) max. See FIGURE 16 in MIL-STD-1472D. (5.4.3.1.7.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	SLIDE SWITCHES
HF Considerations	Direction & Force, Clearance & Separation
Abbreviation	Slide

Detailed Design Considerations	YES	NO	N/A	Comment
220. RESISTANCE: Small switch 10 oz. (280 mN) min., 16 oz. (450 mN) max. Large switch 10 oz. (280 mN) min., 40 oz. (11 N) max. See FIGURE 16 in MIL-STD-1472D. (5.4.3.1.7.3)				
221. SEPARATION: Single finger operation 3/4 in. (19 mm) min., 2 in. (50 mm) optimum. Single finger sequential operation 1/2 in. (13 mm) min., 1 in. (25 mm) optimum. Simultaneous operation by different fingers 5/8 in. (16 mm) min., 3/4 in. (19 mm) max. See FIGURE 16 in MIL-STD-1472D. (5.4.3.1.7.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DISCRETE PUSH-PULL CONTROLS
HF Considerations	Functionality
Abbreviation	Push Pull

Detailed Design Considerations	YES	NO	N/A	Comment
222. Push-pull controls are used for selection of two discrete functions when such applications are typically expected or in special cases when panel space is limited. (5.4.3.1.8.1)				
223. Three-position push-pull controls are used only when inadvertent activation poses no serious consequences. (5.4.3.1.8.1)				
224. Push-pull nonrotating controls are affixed to nonrotating shafts. (5.4.3.1.8.3)				
225. Use, location and operating axis of push-pull control precludes inadvertent activation or catching clothing, communications cables, etc. on control. (5.4.3.1.8.5)				
226. Push-pull rotating controls are equipped with a handle or serrated knob to facilitate a slip-free turning grip. (5.4.3.1.8.3)				
227. Mechanical detents are incorporated to provide tactile indication of positions. (5.4.3.1.8.4)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DISCRETE PUSH-PULL CONTROLS
HF Considerations	Size & Shape
Abbreviation	Push Pull

Detailed Design Considerations	YES	NO	N/A	Comment
228. DIMENSIONS: a) Diameter Low resistance push-pull two position 3/4 in. (19 mm) min. Miniature electrical panel switch 1/4 in. (6 mm) min. b) Width High force push-pull 4 in. (100 mm) min. Handle pulls with gloves 5 in. (125 mm) min. Handle pulls without gloves 4 in. (100 mm) min. c) Length Miniature electrical panel switch 3/4 in. (19 mm) min. d) Depth High force push-pull 5/8 in. (16 mm) min., 1 1/2 in. (38 mm) max. Handle pulls 5/8 in. (16 mm) min., 1 1/2 in. (38 mm) max. See TABLE XI in MIL-STD-1472D. (5.4.3.1.8.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DISCRETE PUSH-PULL CONTROLS
HF Considerations	Size & Shape (Cont.)
Abbreviation	Push Pull

Detailed Design Considerations	YES	NO	N/A	Comment
229. GRASP CLEARANCE: Low resistance push-pull, two position with gloves 1 1/2 in. (38 mm) min. Without gloves 1 in. (25 mm) min. High force push-pull with gloves 1 3/4 in. (31 mm) min. Without gloves 1 in. (25 mm) min. Handle pulls 1 1/2 in. (38 mm) min. See TABLE XI in MIL-STD-1472D. (5.4.3.1.8.2)				
230. DISPLACEMENT: Low resistance push-pull, two position 1/2 in. (13 mm) min., 1 1/2 in. (38 mm) max. Three position push-pull with rotary function 1/2 in. (13 mm) min. between positions. Miniature electrical panel switch 1/2 in. (13 mm) min. High force push-pull 1 in. (25 mm) min., 2 in. (50 mm) preferred. Handle pulls 1 in. (38 mm) min., 2 in. (50 mm) preferred. See TABLE XI in MIL-STD-1472D. (5.4.3.1.8.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DISCRETE PUSH-PULL CONTROLS
HF Considerations	Direction & Force, Clearance & Separation
Abbreviation	Push Pull

Detailed Design Considerations	YES	NO	N/A	Comment
231. Pull turns on or activates; push turns off or deactivates. (5.4.3.1.8.6)				
232. Clockwise rotation is used for increasing function of pull/rotary controls. (5.4.3.1.8.6)				
233. Force for finger pulled controls does not exceed 4 lbs. (1.8 kg). (5.4.3.1.8.7)				
234. Force for four-finger T-bar controls does not exceed 10 lbs. (4.5 kg). (5.4.3.1.8.7)				
235. SEPARATION: Low resistance push-pull, two position with gloves 2 in. (50 mm) min. Without gloves 1 1/2 in. (38 mm) min. Miniature electrical panel switch 1 in. (25 mm) min. Handle pulls 1/2 in. (13 mm) min. See TABLE XI in MIL-STD-1472D. (5.4.3.1.8.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	PRINTED CIRCUIT SWITCHES
HF Considerations	Functionality
Abbreviation	Print Circ

Detailed Design Considerations	YES	NO	N/A	Comment
236. Printed circuit switches are used when manual programming functions are required in systems characterized by printed circuit boards. (5.4.3.1.9.1)				
237. Actuator does not stop between positions. (5.4.3.1.9.2)				
238. When actuators are the slide type, the minimum displacement between settings is twice the length of the actuator. When of rocker type, the actuated wing is flush with module. (5.4.3.1.9.2)				
239. Manipulation of actuators does not require use of special tools. (5.4.3.1.9.2)				
240. Size of actuators permits error-free manipulation with use of some commonly available object as a stylus. (5.4.3.1.9.2)				
241. Actuator surface is sufficiently indented to accept stylus tip and prevent stylus slippage. (5.4.3.1.9.3)				
242. Resistance increases until actuator snaps into position. (5.4.3.1.9.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LEVERS
HF Considerations	Functionality, Size & Shape
Abbreviation	Lever

Detailed Design Considerations	YES	NO	N/A	Comment
243. Latches on levers do not cause delay in operation. (5.4.1.8.3)				
244. Where levers are used for fine or continuous adjustment, limb support is provided as follows: Large hand movements - elbow support provided. Small hand movements - forearm support provided. Finger movements - wrist support provided. (5.4.3.2.1.4)				
245. DIMENSIONS - Handle Diameter: Finger Grasp 0.5 in. (13 mm) min., 1.5 in. (38 mm) max. Hand Grasp 1.5 in. (38 mm) min., 3.0 in. (75 mm) max. See FIGURE 17 in MIL-STD-1472D (5.4.3.2.1.5)				
246. DISPLACEMENT: Forward 14.0 in. (360 mm) max. Lateral 38.0 in. (970 mm) max. (5.4.3.2.1.7)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LEVERS
HF Considerations	Direction & Force, Clearance & Separation
Abbreviation	Lever

Detailed Design Considerations	YES	NO	N/A	Comment
247. RESISTANCE: Forward - One Hand 2 lb. (9 N) min., 30 lb. (135 N) max. Forward - Two Hands 2 lb. (9 N) min., 50 lb. (220 N) max. Lateral - One Hand 2 lb. (9 N) min., 20 lb. (90 N) max. Lateral - Two Hands 2 lb. (9 N) min., 30 lb. (135 N) max. See FIGURE 17 in MIL-STD-1472D. (5.4.3.2.1.6)				
248. SEPARATION: One Hand Random 2 in. (50 mm) min., 4 in. (100 mm) preferred. Two Hands Simultaneously 3 in. (75 mm) min., 5 in. (125 mm) preferred. See FIGURE 17 in MIL-STD-1472D. (5.4.3.2.1.7)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DISPLACEMENT (ISOTONIC) JOYSTICKS
HF Considerations	Functionality
Abbreviation	Disp Stick

Detailed Design Considerations	YES	NO	N/A	Comment
249. Displacement joysticks are used when task requires precise or continuous control movements in two or more related dimensions. (5.4.3.2.2)				
250. Displacement joysticks are used when positioning accuracy is more important than positioning speed. (5.4.3.2.2)				
251. A discrete mechanism is provided for activation/deactivation of the controller. (5.15.2.6.2)				
252. In rate control applications where the cursor or controlled element may move off the display, indication is provided to aid the operator in bringing it back onto the display. (5.4.3.2.2)				
253. In rate control applications, displacement joystick is spring loaded to return to center when the hand is removed. (5.4.3.2.2)				
254. Displacement joystick with center deadband or hysteresis has provision to maintain registration between display center and stick displacement center. (5.4.3.2.2)				
255. Controller movement is smooth in all directions. (5.4.3.2.2.2.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DISPLACEMENT (ISOTONIC) JOYSTICKS
HF Considerations	Functionality (Cont.)
Abbreviation	Disp Stick

Detailed Design Considerations	YES	NO	N / A	Comment
256. Position control of the controlled element or cursor is attained without noticeable backlash, cross-coupling or need for multiple corrective movements. (5.4.3.2.2.1.2, 5.4.3.2.2.2.2)				
257. Control ratio, friction and inertia are suitable for both gross and fine positioning. (5.4.3.2.2.1.2, 5.4.3.2.2.2.2)				
258. Displacement joystick used for free-drawn CRT graphics results in the appearance of a continuous track. Delay between control input and screen response does not exceed 0.1 second. (5.4.3.2.2.1.2, 5.4.3.2.2.2.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DISPLACEMENT (ISOTONIC) JOYSTICKS
HF Considerations	Location & Arrangement
Abbreviation	Disp Stick

Detailed Design Considerations	YES	NO	N/A	Comment
259. Location and mounting of modular controller device allows operation of the stick without slippage, movement or tilting of the mounting base. (5.4.3.2.2.1.3, 5.4.3.2.3.2.3, 5.4.3.2.3.3.3)				
260. Hand operated controllers are located and mounted to provide forearm support. (5.4.3.2.2.1.3)				
261. Finger operated controllers are mounted on a desk or shelf surface. (5.4.3.2.2.2.3)				
262. Finger operated controllers are located and mounted to provide forearm or wrist support. (5.4.3.2.2.2.3)				
263. Thumbtip or fingertip operated controllers are located and mounted to provide forearm or wrist support. (5.4.3.2.2.3.3)				
264. If a thumbtip or fingertip operated controller is mounted on a hand grip, the hand grip does not simultaneously function as a controller. (5.4.3.2.2.3.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DISPLACEMENT (ISOTONIC) JOYSTICKS
HF Considerations	Size & Shape
Abbreviation	Disp Stick

Detailed Design Considerations	YES	NO	N/A	Comment
265. DIMENSIONS: a) Hand Operated Controller Hand Grip Length 4.3 in. (110 mm) min., 7.1 in. (180 mm) max. Hand Grip Diameter 2.0 in. (50 mm) max. See FIGURE 18 in MIL-STD-1472D. (5.4.3.2.2.1.3) b) Finger Operated Controller Finger Grip Length 3.0 in. (75 mm) min., 6.0 in. (150 mm) max. Finger Grip Diameter 0.25 in. (6.5 mm) min., 0.625 in. (16 mm) max. See FIGURE 18 in MIL-STD-1472D. (5.4.3.2.2.2.3)				
266. DISPLACEMENT: Angle From Center 45° (0.8 rad) max. See FIGURE 18 in MIL-STD-1472D. (5.4.3.2.2.1.2, 5.4.3.2.2.2.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DISPLACEMENT (ISOTONIC) JOYSTICKS
HF Considerations	Direction & Force, Clearance & Separation
Abbreviation	Disp Stick

Detailed Design Considerations	YES	NO	N/A	Comment
267. RESISTANCE: Finger Operated Controller 12 oz. (330 mN) min., 32 oz. (890 mN) max. See FIGURE 18 in MIL-STD-1472D. (5.4.3.2.2.2.3)				
268. CLEARANCE: a) Hand Operated Controller Sides 4.0 in. (100 mm) min. Rear 2.0 in. (50 mm) min. See FIGURE 18 in MIL-STD-1472D. (5.4.3.2.2.1.3) b) Finger Operated Controller Display to stick 0 min., 15 3/4 in. (400 mm) max. Around Stick Maximum stick excursion plus 4 in. (100 mm) Stick to shelf front 4 3/4 in. (120 mm) min. 9 7/8 in. (250 mm) max. See FIGURE 18 in MIL-STD-1472D. (5.4.3.2.2.2.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	FORCE (STIFF OR ISOMETRIC) JOYSTICKS
HF Considerations	Functionality
Abbreviation	Force Stick

Detailed Design Considerations	YES	NO	N/A	Comment
269. Force joysticks are used in applications which require: a) Precise return to center after each entry. b) Visual rather than kinesthetic response feedback. c) Minimal delay and tight coupling between control input and system reaction. d) Rapid positioning response rather than high positioning accuracy. (5.4.3.2.3)				
270. Force joysticks are <u>not</u> used in applications in which: a) The operator would be required to apply force over an extended period of time. b) There is no definitive feedback to indicate that maximum control inputs have been exceeded. (5.4.3.2.3)				
271. A discrete mechanism is provided for activation/deactivation of the controller. (5.15.2.6.2)				
272. In rate control applications where the cursor or controlled element may move off the display, indication is provided to aid the operator in bringing it back onto the display. (5.4.3.2.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	FORCE (STIFF OR ISOMETRIC) JOYSTICKS
HF Considerations	Location & Arrangement
Abbreviation	Force Stick

Detailed Design Considerations	YES	NO	N/A	Comment
273. Location and mounting of modular controller device allows operation of the stick without slippage, movement or tilting of the mounting base. (5.4.3.2.3.1.3, 5.4.3.2.3.2.3, 5.4.3.2.3.3.3)				
274. Hand operated controllers are located and mounted to provide forearm support. (5.4.3.2.3.1.3)				
275. Finger operated controllers are mounted on a desk or shelf surface. (5.4.3.2.3.2.3)				
276. Finger operated controllers are located and mounted to provide forearm or wrist support. (5.4.3.2.3.2.3)				
277. Thumbtip or fingertip operated controllers are located and mounted to provide forearm or wrist support. (5.4.3.2.3.2.3)				
278. If a thumbtip or fingertip operated controller is mounted on a hand grip, the hand grip does not simultaneously function as a controller. 5.4.3.2.3.3.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	FORCE (STIFF OR ISOMETRIC) JOYSTICKS
HF Considerations	Size & Shape, Direction & Force, Clearance & Separation
Abbreviation	Force Stick

Detailed Design Considerations	YES	NO	N/A	Comment
279. DIMENSIONS: Hand-Operated Stick <u>Hand Grip Length</u> 4.3 in. (110 mm) min, 7.1 in. (180 mm) max. <u>Hand Grip Diameter</u> 2.0 in. (50 mm) max. (5.4.3.2.3.1.3)				
280. RESISTANCE: Hand-Operated Stick <u>Force for Full Output</u> 26.7 lb. (118 N) max. (5.4.3.2.3.1.2)				
281. CLEARANCE Hand-Operated Stick <u>Sides</u> 4.0 in. (100 mm) min. <u>Rear</u> 2.0 in. (50 mm) min. (5.4.3.2.3.1.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	BALL CONTROLS
HF Considerations	Functionality
Abbreviation	Ball

Detailed Design Considerations	YES	NO	N/A	Comment
282. Ball control is used for applications which require accumulative travel of the controlled element or cursor in a given direction. (5.4.3.2.4.1)				
283. Ball control is used only as a position control where cursor position is proportional to ball rotation angle. (5.4.3.2.4.1)				
284. In applications where the cursor or controlled element may move off the display, indication is provided to aid the operator in bringing it back onto the display. (5.4.3.2.4.1)				
285. Ball control is capable of rotation in any direction necessary to produce any combination of X and Y cursor positions. (5.4.3.2.4.2)				
286. Ball rotates smoothly in any direction without backlash or cross-coupling. (5.4.3.2.4.2)				
287. Control ratios and dynamic features are appropriate for both rapid gross and precise fine positioning. (5.4.3.2.4.2)				
288. A discrete mechanism is provided for activation/deactivation. (5.15.2.6.2)				
289. Suitable wrist and/or arm support is provided for precise or continuous adjustments. (5.4.3.2.4.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	BALL CONTROLS
HF Considerations	Size & Shape, Direction & Force
Abbreviation	Ball

Detailed Design Considerations	YES	NO	N / A	Comment
290. DIMENSIONS: Diameter 2.0 in. (50 mm) min., 6.0 in. (150 mm) max., 4.0 in. (100 mm) preferred. Surface exposure 100° (1545 mrad) min., 140° (2445 mrad) max., 120° (2095 mrad) preferred. See FIGURE 19 in MIL-STD-1472D. (5.4.3.2.4.4)				
291. Smaller diameter ball controls are used only under severe space constraints and when precision is not essential. (5.4.3.2.4.4)				
292. RESISTANCE: Precision required 3.6 oz. (1 N) max., 1.1 oz. (0.3 N) preferred. Vibration or acceleration conditions 6 oz. (1.7 N) max. See FIGURE 19 in MIL-STD-1472D. (5.4.3.2.4.4)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	**BALL CONTROLS**
HF Considerations	**Clearance & Separation**
Abbreviation	**Ball**

Detailed Design Considerations	YES	NO	N/A	Comment
293. CLEARANCE: <u>Display to ball</u> 0 min., 12.675 in. (320 mm) max. <u>Around ball</u> 2.0 in. (50 mm) min. <u>Ball to shelf front</u> 4.75 in. (120 mm) min., 9.75 in. (250 mm) max. See FIGURE 19 in MIL-STD-1472D. (5.4.3.2.4.4)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	GRID & STYLUS DEVICES
HF Considerations	Functionality
Abbreviation	Grid

Detailed Design Considerations	YES	NO	N/A	Comment
294. Grid-and-stylus device is used for CRT data retrieval, entry of points on a display, generation of free-drawn graphics or similar applications. (5.4.3.2.5.1)				
295. Grid & stylus device is used only for position control where the cursor displacement is proportional to stylus displacement from the reference point. (5.4.3.2.5.1)				
296. Movement of stylus in any direction on the grid surface results in a proportional movement of cursor on display. (5.4.3.2.5.2)				
297. Discrete placement of stylus at any point on grid causes the cursor to move to the corresponding position and remain at this position until the stylus is moved along the grid or placed at another discrete point on the grid. (5.4.3.2.5.2)				
298. The refresh rate for the cursor is great enough to create the appearance of a continuous track for free drawn graphics. (5.4.3.2.5.2)				
299. A discrete mechanism is provided for activation/ deactivation. (5.15.2.6.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	GRID & STYLUS DEVICES
HF Considerations	Size & Shape
Abbreviation	Grid

Detailed Design Considerations	YES	NO	N/A	Comment
300. Transparent grids used as display overlays conform to the size of the display. (5.4.3.2.5.3)				
301. Displaced grids approximately the size of the display are mounted below the display. (5.4.3.2.5.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	FREE MOVING XY CONTROLLER (MOUSE)
HF Considerations	Functionality
Abbreviation	Mouse

Detailed Design Considerations	YES	NO	N / A	Comment
302. Free-moving controllers are used on flat surface to control the position of the cursor on the display. (5.4.3.2.6.1)				
303. Free-moving controllers are used for data retrieval or entry. (5.4.3.2.6.1)				
304. Free-moving controllers are not used for constructing free drawn graphics. (5.4.3.2.6.1)				
305. Cursor displacement is proportional to controller displacement. (5.4.3.2.6.2)				
306. Controller is operable with either hand. (5.4.3.2.6.2)				
307. In applications where the cursor or controlled element may move off the display, indication is provided to aid the operator in bringing it back onto the display. (5.4.3.2.6.2)				
308. The controller allows the operator to consistently orient it to within 10° (175 mrad) of the intended orientation. (5.4.3.2.6.2)				
309. The controller is readily operated in any direction without a change of hand grasp. (5.4.3.2.6.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	FREE MOVING XY CONTROLLER (MOUSE)
HF Considerations	Functionality, Size & Shape
Abbreviation	Mouse

Detailed Design Considerations	YES	NO	N/A	Comment
310. A complete excursion of the controller from one side of the maneuvering area to the other moves the cursor from one side of the screen to the other regardless of scale setting unless expanded movement has been selected. (5.4.3.2.6.2)				
311. A discrete mechanism is provided for activation/ deactivation. (5.15.2.6.2)				
312. The free-moving controller is approximately rectangular in shape with no sharp edges. (5.4.3.2.6.3)				
313. DIMENSIONS <u>Width spanned by finger to thumb grasp</u>: 1.6 in. (40 mm) min., 2.8 in. (70 mm) max. <u>Length</u>: 2.8 in. (70 mm) min., 4.7 in. (120 mm) max. <u>Thickness</u>: 1.0 in. (25 mm) min., 1.6 in. (40 mm) max. (5.4.3.2.6.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LIGHT PEN
HF Considerations	Functionality
Abbreviation	Light Pen

Detailed Design Considerations	YES	NO	N / A	Comment
314. Light pens are used as a track oriented designation device or as a substitute controller for grid and-stylus devices. (5.4.3.2.7.1)				
315. Light pens are used for item selection type data entry tasks. (5.15.2.5.1)				
316. Light pens are <u>not</u> used where critical or precise input functions are required. (5.15.2.5.1)				
317. Light pens are equipped with a discrete activating/deactivating mechanism. (5.15.2.5.3)				
318. A clip is installed at the lower right side of the CRT to serve as a pen holder. (5.4.3.2.7.3)				
319. Feedback is provided for light pen placement on the screen. (5.15.2.5.4)				
320. Feedback is provided for light pen actuation and reception of input. (5.15.2.5.4)				
321. Discrete placement of light pen at any point on grid causes the cursor to move to the corresponding position and remain at this position until the pen is moved along the grid or placed at another discrete point on the grid. (5.4.3.2.7.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LIGHT PEN
HF Considerations	Size & Shape, Dirction & Force
Abbreviation	Light Pen

Detailed Design Considerations	YES	NO	N / A	Comment
322. DIMENSIONS: <u>Length</u> 4.7 in. (120 mm) min., 7.1 in. (180 mm) max. <u>Diameter</u> 0.3 in (7.6 mm) min., 0.8 in. (20.3 mm) max. (5.4.3.2.7.3)				
323. RESISTANCE: Light pen push-tip switches. if used, require actuation force as follows: 2.0 oz. (0.5 N) min., 5.0 oz. (1.4 N) max. (5.15.2.5.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	PEDALS
HF Considerations	Functionality
Abbreviation	Pedal

Detailed Design Considerations	YES	NO	N/A	Comment
324. Pedals are used: a) When control operation requires greater force than upper body can supply. b) When force approaches upper body fatigue threshold. c) When both operator's hands are busy with other controls. d) To conform to control stereotypes. e) As provision for alternate safety shut-down control. f) For distribution of workload. (5.4.1.8.6.1, 5.4.3.2.8.1)				
325. Pedals are <u>not</u> used: a) If balance-imposed risks exist for standing operators. b) When control precision is required. c) When selection among many controls is required. (5.4.1.8.6.2)				
326. Pedal operation does <u>not</u> require: a) Frequent maximum reaching. b) Holding leg or foot in awkward position for extended period of time. c) Frequent operation or extended period of time in a twisted seating position. d) Maximum force application frequently or for extended period of time. e) Search for one pedal among many. (5.4.1.8.6.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	PEDALS
HF Considerations	Location & Arrangement, Size & Shape
Abbreviation	Pedal

Detailed Design Considerations	YES	NO	N/A	Comment
327. Pedals can be reached without stretching or twisting at torso. (5.4.3.2.8.2)				
328. A heel rest is provided when pedal angle exceeds 20° from the horizontal. (5.4.3.2.8.2)				
329. Pedal returns to original position when foot is removed. (5.4.3.2.8.3)				
330. Pedal is located to avoid accidental activation, entrapment of the foot and entrapment of clothing. (5.4.1.8.6.3				
331. The following are provided to facilitate leverage where high pedal force is required : a) Seat backrests. b) Seat height/pedal arrangement to create an upper thigh to lower leg angle of approximately 160° (2790 mrad). c) Double width pedals. (5.4.3.2.8.5)				
332. DIMENSIONS: <u>Height</u> 1.0 in. (25 mm) min. <u>Width</u> 3.0 in. (75 mm) min. See FIGURE 20 in MIL-STD-1472D. (5.4.3.2.8.7)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	**PEDALS**
HF Considerations	**Size & Shape (Cont.)**
Abbreviation	**Pedal**

Detailed Design Considerations	YES	NO	N/A	Comment
333. DISPLACEMENT: Normal Operation 0.5 in. (13 mm) min., 2.5 in. (65 mm) max. Heavy Boots 1.0 in. (25 mm) min., 2.5 in. (65 mm) max. Ankle Flexion 1.0 in. (25 mm) min., 2.5 in. (65 mm) max. Total Leg Movement 1.0 in. (25 mm) min., 7.0 in. (180 mm) max. See FIGURE 20 in MIL-STD-1472D. (5.4.3.2.8.7)				
334. Pedals requiring high force application have non-skid surface. (5.4.3.2.8.6)				

YES = Adequate **NO = Inadequate** **N/A = Not Applicable**

DESIGN CHECKLIST

Components	PEDALS
HF Considerations	Direction & Force, Clearance & Separation
Abbreviation	Pedal

Detailed Design Considerations	YES	NO	N/A	Comment
335. RESISTANCE: Foot Not Resting on Pedal 4 lb. (18 N) min., 20 lb. (90 N) max. Foot Resting on Pedal 10 lb. (45 N) min., 20 lb. (90 N) max. Ankle Flexion Only 10 lb. (45 N) max. Total Leg Movement 10 lb. (45 N) min., 180 lb. (800 N) max. See FIGURE 20 in MIL-STD-1472D. (5.4.3.2.8.7)				
336. Sufficient resistance is incorporated to prevent inadvertent activation while foot is resting on pedal. (5.4.3.2.8.3)				
337. SEPARATION: One Foot Random 4.0 in. (100 mm) min., 6.0 in. (150 mm) preferred. One Foot Sequential 2.0 in. (50 mm) min., 4.0 in. (100 mm) preferred. See FIGURE 20 in MIL-STD-1472D. (5.4.3.2.8.7)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	HIGH FORCE CONTROLS
HF Considerations	Location & Arrangement, Force, Operating Procedures
Abbreviation	High Force

Detailed Design Considerations	YES	NO	N/A	Comment
338. Forces are below strength limits of the lowest segment of the user population. (5.4.4.1)				
339. Controls provide appropriate limb and body support. (5.4.4.1)				
340. Maximum sustained operation is 3 seconds. (5.4.4.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	MINIATURE CONTROLS
HF Considerations	Functionality, Size, Force, Separation, Use Conditions
Abbreviation	Min

Detailed Design Considerations	YES	NO	N/A	Comment
341. Miniature controls are used only under severe space constraints. (5.4.5.1)				
342. Miniature controls are used when heavy gloves or mittens are not required. (5.4.5.1)				
343. Size and separation is the maximum for the space allotted. (5.4.5 2)				
344. Resistance and displacement requirements are equivalent to standard size controls. (5.4.5.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	TOUCH-SCREENS
HF Considerations	Functionality, Size, Force, Separation
Abbreviation	Touch

Detailed Design Considerations	YES	NO	N/A	Comment
345. Touch-screen is used where direct visual reference and direct control access to a display device is required. (5.4.6.1)				
346. Positive indication is provided of the response of the system to the control action. (5.4.6.3)				
347. DIMENSIONS: The dimensions of responsive areas of the touch-screen conform to those required for legend switches as follows: 0.75 in. (19 mm) min., 1.5 in. (38 mm) max. See FIGURE 14 in MIL-STD-1472D. (5.4.6.4)				
348. RESISTANCE: 0.9 oz. (250 mN) min., 5.3 oz. (1.5 N) max. (5.4.6.5)				
349. SEPARATION: The separation between responsive areas of the touch-screen conforms to the barrier width required for legend switches as follows: 0.125 in. (3 mm) min., 0.25 in. (6 mm) max. See FIGURE 14 in MIL-STD-1472D. (5.4.6.4)				

YES = **Adequate** **NO** = **Inadequate** **N/A** = **Not Applicable**

DESIGN CHECKLIST

Components	TOUCH-SCREENS
HF Considerations	Visibility & Identification
Abbreviation	Touch

Detailed Design Considerations	YES	NO	N/A	Comment
350. Luminance transmittance of touch-screen allows the display to be read easily in the intended illumination environment. (5.4.6.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CIRCUIT BREAKER
HF Considerations	Functionality, Size & Shape, Force, Separation
Abbreviation	Breaker

Detailed Design Considerations	YES	NO	N/A	Comment
351. Circuit breaker controls are of the toggle bat or legend switch type. (5.9.17.2.4)				
352. Push-pull breakers are not used as power switches. (5.9.17.2.4)				
353. Toggle bat actuated breakers comply with design criteria for toggle switches. (5.9.17.2.5)				
354. Legend switch actuated breakers comply with design criteria for legend switches. (5.9.17.2.5)				
355. Push-pull actuated breakers comply with design criteria for discrete push-pull controls. (5.9.17.2.5)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONTROLED CURSORS
HF Considerations	Functionality, Size & Shape
Abbreviation	Cursor

Detailed Design Considerations	YES	NO	N/A	Comment
356. Cursor sensitivity/speed is adjustable by user. (5.15.2.1.8.1)				
357. If fine positioning accuracy is required, the cursor has a point designation feature. (5.15.2.1.8.2)				
358. Cursor home position is consistent across similar types of displays. (5.15.2.1.8.3)				
359. Where a position on the display is to be designated, this is accomplished by a control action distinct from that used to move the cursor. (5.15.2.1.8.4)				
360. Cursor movement increment (step size) is consistent horizontally (both right and left) and vertically (both up and down). (5.15.2.1.8.5)				
361. Where the primary task is keyboard data entry, the cursor is controlled by a key or by a device located on the main keyboard. (5.15.2.1.8.6)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONTROLED CURSORS
HF Considerations	Direction, Visibility & Illumination
Abbreviation	Cursor

Detailed Design Considerations	YES	NO	N / A	Comment
362. The direction of cursor movement in response to a control input is consistent, predictable and compatible with the user's expectations. (5.15.2.1.8.7)				
363. Movable cursors can be readily distinguished from other display elements. (5.15.2.1.8.2)				
364. Movable cursors do not obscure other displayed information. (5.15.2.1.8.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	COMPUTER DATA ENTRY
HF Considerations	Functionality, Size & Shape
Abbreviation	Data Entry

Detailed Design Considerations	YES	NO	N/A	Comment
365. Data entry is paced by the user. (5.15.2.1.1)				
366. The system provides positive feedback to the user of the acceptance or rejection of a data entry. (5.15.2.1.2)				
367. Where system overload or other system conditions will result in a processing delay, the system: a) Acknowledges data entry. b) Provides an indication of the delay to the user. (5.15.2.1.3)				
368. Data entry requires an explicit completion action, such as the depression of an ENTER key. (5.15.2.1.4)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	INTERACTIVE COMPUTER CONTROL
HF Considerations	Functionality
Abbreviation	Int Control

Detailed Design Considerations	YES	NO	N/A	Comment
369. Control dialog type is consistent with task requirements and user skills. (5.15.4.1)				
370. System response time following control action is consistent with operational requirements. (5.15.4.1.1)				
371. Keyboard lockout is provided where appropriate because of processing time. (5.15.4.1.1.1)				
372. If keyboard lockout occurs, indication is provided of the locked/available status of the keyboard. (5.15.4.1.1.2)				
373. If keyboard lockout occurs, a capability is provided to abort the transaction without losing inputs which occurred prior to the lockout. (5.15.4.1.1.3)				
374. Control/display relationships are straightforward and explicit. (5.15.4.1.2)				
375. Control actions are simple and direct. (5.15.4.1.2)				
376. Provisions are made to prevent accidental actuation of potentially destructive control actions, including the possibility of accidental erasure or memory dump. (5.15.4.1.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	INTERACTIVE COMPUTER CONTROL
HF Considerations	Functionality (Cont.)
Abbreviation	Int Control

Detailed Design Considerations	YES	NO	N/A	Comment
377. Controls are compatible with the lowest anticipated user skill levels. (5.15.4.1.4)				
378. Information necessary to select or enter a control action is available to the user when the control action is appropriate. (5.15.4.1.5)				
379. User control inputs result in a positive feedback response displayed to indicate performance of requested actions. (5.15.4.1.6)				
380. Control feedback responses to correct user input consists of changes in state or value of those elements of the displays which are being controlled. (5.15.4.1.13)				
381. The displayed cursor is advanced by a tab key to the next data entry field when the user has completed entry of the current field. (5.15.4.3.6)				
382. A control is provided for user acceptance of stored data values or defaults. (5.15.6.7)				
383. Provision is made for the user to stop the computer control process and return to the state prior to the last control input. (5.15.8.6)				
384. In multi-step processes, provision is made for the user to return to previous levels. (5.15.8.6)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	INTERACTIVE COMPUTER CONTROL
HF Considerations	Functionality (Cont.)
Abbreviation	Int Control

Detailed Design Considerations	YES	NO	N/A	Comment
385. When the user enters correction of an error, such corrections are implemented by an explicit action by the user (e.g., actuation of an ENTER key). (5.15.8.8)				
386. The system requires the user to acknowledge critical entries prior to their being implemented by the system. (5.15.8.4)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	MENU SELECTION COMPUTER CONTROL
HF Considerations	Functionality
Abbreviation	Menu

Detailed Design Considerations	YES	NO	N / A	Comment
387. System response time following menu input is 0.2 sec. or less. See TABLE XXVIII in MIL-STD-1472D. (5.15.4.1)				
388. Light pens or other pointing devices are used for menu selection. (5.15.4.2.2.1)				
389. Separate control actions are provided for: a) Designating a menu choice b) Entering the menu choice. (5.15.4.2.2.1)				
390. A capability is provided to stack menu choices for execution in a sequence without having each menu displayed. (5.15.4.2.2.3)				
391. Where a hierarchy of menus is used, a capability is provided to directly command items in submenus without having each menu displayed. (5.15.4.2.8)				
392. Where a hierarchy of menus is used, a capability is provided to return to the next higher level menu. (5.15.4.2.13)				
393. Where a hierarchy of menus is used, a capability is provided to return to the top level menu. (5.15.4.2.14)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	FORM FILLING COMPUTER CONTROL
HF Considerations	Functionality
Abbreviation	Form

Detailed Design Considerations	YES	NO	N/A	Comment
394. A TAB key or other control is provided to advance the cursor to the next field in the form. (5.15.4.3.6)				
395. Form filling dialog is provided where composition of complex control sequences is necessary. (5.15.4.3.16)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	COMMAND LANGUAGE COMPUTER CONTROL
HF Considerations	Functionality
Abbreviation	Cmd Lang

Detailed Design Considerations	YES	NO	N/A	Comment
396. The command language reflects the user's point of view such that the commands are logically related to the user's conception of what is being done. (5.15.4.5.2)				
397. Commands are distinctive from one another. (5.15.4.5.3)				
398. The command language contains a minimum of punctuation or other special characters. (5.15.4.5.4)				
399. The user is permitted to enter the full command name or an abbreviation for any command of more than 5 characters. (5.15.4.5.5)				
400. All commands and their abbreviations, if any, are standardized and consistent with MIL-STD-12, MIL-STD-411, or MIL-STD-783. (5.15.4.5.6)				
401. Commands are entered and displayed in a standard location on the display. (5.15.4.5.7)				
402. The user is able to request prompts, as necessary, to determine required parameters in a command entry. (5.15.4.5.8)				
403. Command language structure and complexity is consistent with user skill level. (5.15.4.5.9)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	COMMAND LANGUAGE COMPUTER CONTROL
HF Considerations	Functionality (Cont.)
Abbreviation	Cmd Lang

Detailed Design Considerations	YES	NO	N/A	Comment
404. User defined macro names which are the same as a reserved word in the command language are not accepted by the system. (5.15.4.5.10)				
405. Capability is provided for command editing using the same techniques employed for editing of other data entries. (5.15.4.5.11)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	TEXT/PROGRAM EDITING CONTROL
HF Considerations	Functionality
Abbreviation	Edit

Detailed Design Considerations	YES	NO	N/A	Comment
406. ROLL and SCROLL commands refer to the display window, not the text/data. (5.15.3.7.3)				
407. Easy-to-use special editing commands such as MOVE, COPY, and DELETE, for adding, inserting, or deleting text/program segments are provided. (5.15.3.7.4)				
408. Text editing commands are based on character, word, sentence, paragraph or higher-order segments. (5.15.3.7.4.1)				
409. Program editing commands are based on lines or subprograms. (5.15.3.7.4.2)				
410. When available, line-by-line syntax checking is under user control. (5.15.3.7.4.2)				
411. For editing programs or tabular data, cursor tab controls or other provisions for establishing and moving readily from field to field are provided. (5.15.3.7.4.3)				
412. Where editing commands are entered by keying onto the display, the editing commands are readily distinguishable from the displayed text. (5.15.3.7.5)				
413. An easy-to-use means is provided for specification of format control features during editing. (5.15.3.7.9)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	TEXT/PROGRAM EDITING CONTROL
HF Considerations	Functionality (Cont.)
Abbreviation	Edit

Detailed Design Considerations	YES	NO	N/A	Comment
414. In printing text, the capability is provided for the user to select printing options. (5.15.3.7.14)				
415. Capability is provided to readily move the cursor to the head (start) or foot (end) of the text file. (5.15.3.7.15)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

6. SPECIAL CONTROLS

DESIGN CHECKLIST

Components	SPECIAL CONTROLS
HF Considerations	Functionality
Abbreviation	Function

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N / A	Comment
1. Aircraft control design conforms to requirements of applicable standards for aircraft stations including: MIL-STD-203 MIL-STD-250 MIL-STD-411 MIL-STD-783 MIL-STD-850 MIL-STD-1333 MIL-STD-1776 MIL-STD-1787 MIL-STD-1800 MIL-STD-1801 MIL-L-5667 MIL-L-85762 MIL-L-87240 MIL-M-18012 MIL-P-7788 AFGS-87213A. (5.14.2.1)				
2. Firing mechanism for ejection seats is located or protected to preclude inadvertent actuation. (5.14.4.3.4)				
3. Aircraft ejection system design conforms to the requirements of MIL-S-9479 or MIL-S-18471. (5.14.4.3)				
4. Fixed wing aircraft control actuations conform to requirements of MIL-STD-203.				
5. Rotary wing aircraft control actuations conform to requirements of MIL-STD-250.				
6. Ejection controls are operable by 3rd to 98th percentile crewman.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	SPECIAL CONTROLS
HF Considerations	Functionality (Cont.)
Abbreviation	Function

Detailed Design Considerations	YES	NO	N/A	Comment
7. Controls, switches, control guards, and covers are operable by gloved hand. (5.4.1.6)				
8. Rotary aircraft collective control design conforms to the requirements of MIL-STD-1333.				
9. Actuation of controls and switches involving flight safety are consistent with previous models of the particular aircraft.				
10. Ejection controls do not jeopardize user's safety or hinder emergency escape.				
11. Single, multiple throttle control design conforms to the requirements of MIL-STD-1333 except that multiple throttle design is based on forward most position of throttle farthest from crewman.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	SPECIAL CONTROLS
HF Considerations	Location & Arrangement
Abbreviation	Loc

Detailed Design Considerations	YES	NO	N/A	Comment
12. Ejection controls are readily accessible and are operable by either hand. (5.14.4.3.3)				
13. Landing gear lock/release is operable by hand or foot. (5.12.7.1.4)				
14. Fixed wing aircraft cockpit control locations conform to requirements of MIL-STD-203.				
15. Rotary wing aircraft cockpit control locations conform to requirements of MIL-STD-250.				
16. Aircraft controls are operable with shoulder harness locked.				
17. Rotary wing aircraft have no emergency control that requires the removal of the pilot's right hand from the cyclic stick.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	SPECIAL CONTROLS
HF Considerations	Direction & Force
Abbreviation	Dir

Detailed Design Considerations	YES	NO	N/A	Comment
18. All "conventional" controls have direction of movement which is consistent with the related movement of an associated display, equipment, component or vehicle. (5.4.1.2.1)				
19. All "performance-related" controls are designed so that actuation forward, clockwise, to the right or upward results in an increase in the quantity being controlled. (5.4.1.2.1)				
20. Controls for multidimensional operation have direction of motion relationships which are consistent with operator expectations. (5.4.1.2.2)				
21. Overhead switch actuation increases the quantity being controlled when moved: a) Upward, if the panel forms an angle of 0° to 30° (0 to 0.52 rad) with respect to the vertical axis. b) Forward, if the panel forms an angle greater than 30° (0.52 rad) and equal to or less than 90° (1.57 rad).				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	SPECIAL CONTROLS
HF Considerations	Direction & Force (Cont.)
Abbreviation	Dir

Detailed Design Considerations	YES	NO	N/A	Comment
22. Primary or curtain ejection control force : Extract 20 lb. (9 kg) min., 40 lb. (18 kg) max. Fire 30 lb. (14 kg) min., 40 lb. (18 kg) max. Alternate or D-ring: Extract 20 lb. (9 kg) min., 40 lb. (18 kg) max. Fire 30 lb. (14 kg) min., 40 lb. (18 kg) max.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	SPECIAL CONTROLS
HF Considerations	Clearance & Separation
Abbreviation	Clear

Detailed Design Considerations	YES	NO	N/A	Comment
23. Pitch and roll control clearances conform to the requirements of MIL-STD-1333.				
24. Yaw control clearances conform to the requirements of MIL-STD-1333..				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	SPECIAL CONTROLS
HF Considerations	Visibility & Identification
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N/A	Comment
25. Emergency controls are coded using yellow and black stripes or background. (5.4.1.4.5.5)				
26. Emergency control colors are limited to grey, black, white or yellow.				
27. Printed instructions in the cockpit are minimized and lighted.				
28. Cockpit information is displayed: lettering, numbering, markings, symbols on displays, controls, and control panels; emergency procedures for exiting and ditching; flight and operational procedures; radio call signs.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

7. DISPLAYS

DESIGN CHECKLIST

Components	CONTROL/DISPLAY INTEGRATION
HF Considerations	Functionality
Abbreviation	CD Int

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N / A	Comment
1. Relationship between the display and its associated controls are unmistakable in terms of: a) The proper control to use. b) Direction of movement of the control. c) Rate and limits of movement of the control. (5.1.1.1)				
2. Functionally related units are grouped together and are similar from panel to panel. (5.1.2.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONTROL/DISPLAY INTEGRATION
HF Considerations	Location & Arrangement
Abbreviation	CD Int

Detailed Design Considerations	YES	NO	N/A	Comment
3. A visual display which must be monitored concurrently while activating a related control is located to prevent parallax. (5.1.2.3.3)				
4. All displays are arranged in the sequence in which they are used. (5.1.2.1.1.1)				
5. Controls are located adjacent to (either under or to the right of) associated displays. (5.1.1.1)				
6. Displays in groups are located from left-to-right and/or top to-bottom order of use. (5.1.2.1.1.1)				
7. Displays used in system checkout are located so they can be observed from one position.				
8. Emergency visual displays are located within a 30° (0.52 rad) cone about the operator's normal line of sight. (5.1.2.3.8)				
9. If frequent or precision reading is required, displays are located 50 to 65 in. (127 to 165 cm) above standing surface. (5.7.2.3)				
10. Control & display groups for maintenance use only are not located in prime operating space. (5.1.2.1.1.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DISPLAYS
HF Considerations	Functionality
Abbreviation	Function

Detailed Design Considerations	YES	NO	N/A	Comment
11. Displays provide updated information in a synchronous manner corresponding to the degree of timeliness required by personnel in normal operating modes. (5.2.1.3.10)				
12. Displays which cannot or may not be watched continuously, but need continuous monitoring, have a suitable auditory or visual warning backup.				
13. Information displayed is at a level of accuracy required for the operator's action or decision. (5.2.1.3.1)				
14. Display scales are limited to only that information needed to make a decision or take action. All needed information is presented. (5.2.1.3.1)				
15. Multifunction displays providing integrated information advise or alert the operator to critical information within the display. (5.2.1.3.11)				
16. The information displayed is clear, specific, and useable and is not redundant or degraded by vibration. (5.2.1.4.5)				
17. The precision of the display presentation is consistent with system precision. (5.2.1 3.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DISPLAYS
HF Considerations	Functionality (Cont.)
Abbreviation	Function

Detailed Design Considerations	YES	NO	N/A	Comment
18. Trademarks and company names or other similar markings not related to panel function are not displayed on the panel face. (5.2.1.3.8)				
19. Audio signals and visually displayed information are of sufficient duration to be reliably detected. (5.2.1.3.9)				
20. The display indicator ceases to move after the control movement stops. (5.1.3.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DISPLAYS
HF Considerations	Location & Arrangement
Abbreviation	Loc

Detailed Design Considerations	YES	NO	N/A	Comment
21. Display arrangement is consistent from one situation to another. (5.2.1.4.10)				
22. Displays are located where they can be read to the required degree of accuracy. (5.2.1.4.1)				
23. Frequently used displays are grouped together and are placed in the optimal visual zone. See FIGURES 1 and 2 in MIL-STD-1472D. (5.2.1.4.8)				
24. Frequently used displays are grouped together. (5.2.1.4.8)				
25. If on separate panels, the positions of related controls and displays correspond and the panels do not face each other. (5.1.2.3.6)				
26. Important or critical displays are located in a privileged position within a 30° (0.52 rad) cone about the operator's normal line of sight or otherwise highlighted. (5.2.1.4.9)				
27. In sequential displays, the sequence progresses from left to right. (5.2.1.4.7)				
28. In standing positions, the most frequently used displays are located approximately at the eye level of the operator. (5.7.2.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	**DISPLAYS**
HF Considerations	**Location & Arrangement (Cont.)**
Abbreviation	**Loc**

Detailed Design Considerations	YES	NO	N/A	Comment
29. Information for different types of activities is not combined unless the activities require the same information. (5.2.1.3.5)				
30. Information is presented in such form that no interpretation or decoding is necessary. (5.2.1.3.3)				
31. Meters, dials, and instruments are so sized and arranged that they can be read from the normal operating position. (5.2.1.4.1)				
32. On units without an operational panel, maintenance displays are located on one face accessible in normal installation. (5.2.1.4.1)				
33. Trademarks, company names, and other unnecessary information are not on the panel face. (5.2.1.3.8)				
34. Unusual aids such as ladders, extra lighting, etc., are not needed to read or gain access to a display. (5.2.1.4.2)				

YES = Adequate **NO = Inadequate** **N/A = Not Applicable**

DESIGN CHECKLIST

Components	DISPLAYS
HF Considerations	Direction
Abbreviation	Dir

Detailed Design Considerations	YES	NO	N/A	Comment
35. Scale values and their indexes are consistent in direction of increase or decrease. (5.2.3.2.1)				
36. Rotation of controls is clockwise to increase the associated indication. (5.2.3.2.3.2)				
37. Display numbers increase from bottom to top or from left to right. (5.2.3.3.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DISPLAYS
HF Considerations	Visibility & Identification
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N/A	Comment
38. A viewing distance of up to 30 inches (760 mm) is used with ejection seats. (5.2.1.4.11)				
39. A seated viewing distance of up to 25 inches (635 mm) is provided. (5.2.1.4.11)				
40. Adjustable illumination is provided for displays that must be monitored under variable lighting conditions. (5.1.1.5)				
41. Color or other coding technique is used where possible. (5.2.1.5.2)				
42. Cover glass on displays does not fog up.				
43. Dials are visible to arctic-clothed user. (5.6.4)				
44. Glare does not interfere with readability of the display at a location. (5.2.1.4.4)				
45. Illumination is uniform. (5.2.1.2)				
46. Integrally illuminated displays are uniformly lighted such that the ratio of the standard deviation of indicator element luminances to mean indicator luminance is not more than .25, using eight or more equally spaced test measurements. (5.2.1.2.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DISPLAYS
HF Considerations	Visibility & Identification (Cont.)
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N/A	Comment
47. Most important displays are placed in the optimum visual zone. See FIGURES 1 and 2 in MIL-STD-1472D. (5.2.1.4.9)				
48. Panel light levels are continuously variable from 0.03 ft-L (0.1 cd/sq m) near OFF to 1.0 ft-L (3.5 cd/sq m) at 50% of clockwise rotation. (5.2.1.2.1.3)				
49. The display can be read quickly in the manner desired (quantitative, qualitative, or check reading). (5.2.1.3.3)				
50. The display face is not less than 45° (0.8 rad) from the operator's normal line of sight. See FIGURE 1 in MIL-STD-1472D. (5.2.1.4.3)				
51. The effective viewing distance to displays, with the exception of cathode ray tube displays and collimated displays, is not less than: 13 in (330 mm) min., 20 inches (510 mm) preferred. (5.2.1.4.12)				
52. The viewing distance from the eye reference point of the seated operator to displays located close to their associated controls does not exceed 25 in (635 mm). (5.2.1.4.11)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DISPLAYS
HF Considerations	Visibility & Identification (Cont.)
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N/A	Comment
53. When complete dark adaptation is required, low luminance [0.02 - 0.10 ft-L (0.07 - 0.35 cd/sq m)] red light (greater than 620 nm) is provided. (5.2.1.2.1.1)				
54. When control or annunciator panels will be viewed by personnel out of doors at night, maximum panel illumination is provided when a dimming rotary control is at its extreme clockwise rotation. (5.2.1.2.1.3)				
55. When maximum dark adaptation is not required, low brightness white light is used. (5.2.1.2.1.1)				
56. Multiple displays grouped together will have brightness uniformity across the range of full ON to full OFF. (5.2.1.2)				
57. Where multiple displays are grouped together, lighting is balanced across the instrument panel such that the mean indicator luminances of any two instruments do not differ by more than 33% across the range of full ON to full OFF. (5.2.1.2.2)				
58. Where night vision device compatibility is required, display illumination color other than red is used. (5.2.1.2.1.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DISPLAYS
HF Considerations	Visibility & Identification (Cont.)
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N / A	Comment
59. Where night vision device compatibility is required, lighting is continuously variable to the full OFF position. In the OFF position, no current flows through the lamps. (5.2.1.2.1.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	**DISPLAYS**
HF Considerations	**Use Conditions, Safety**
Abbreviation	**Use**

Detailed Design Considerations	YES	NO	N/A	Comment
60. Mechanical overlays, such as coverings over keyboards or transparent sheets placed on displays, are not used. (5.15.10.1)				
61. Failure in the unit is clearly shown or the operator is otherwise warned. (5.2.1.3.6)				
62. Failure of a display circuit is immediately apparent. (5.2.1.3.6)				
63. Failure of the display circuit does not affect display equipment. (5.2.1.3.7)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	TRANSILLUMINATED DISPLAYS
HF Considerations	Functionality
Abbreviation	Trans

Detailed Design Considerations	YES	NO	N / A	Comment
64. Dimming capability to full OFF is provided only for lighted indicators providing non-critical operational information. (5.2.2.1.10)				
65. Flashing lights are used only to call the operator's attention to a condition requiring action. (5.2.2.1.19)				
66. Indicator lights are capable of providing flashing red for emergency or malfunction conditions. (5.2.2.1.9)				
67. Indicator lights only show information needed for effective system operation. (5.2.2.1.3)				
68. A signal absence denotes only a "power off" condition and does not denote "go ahead", "ready," etc. (5.2.2.1.4)				
69. Indicator lights show equipment response, not merely control position and are used sparingly. (5.2.2.1.2)				
70. Legend lights are used in preference to simple indicator lights. (5.2.2.2.1)				
71. Lighted indicators display qualitative information to the operator concerning system status or required immediate actions. (5.2.2.1.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	TRANSILLUMINATED DISPLAYS
HF Considerations	Functionality (Cont.)
Abbreviation	Trans

Detailed Design Considerations	YES	NO	N/A	Comment
72. Luminance controls for lighted indicators are capable of making multiple step or continuously variable illumination adjustments. (5.2.2.1.10)				
73. Transilluminated (integrally lighted) panel assemblies are used to: a) Provide illuminated labels for a control panel. b) Provide a light source for transilluminated knobs and/or association markings on a control panel. c) Create a pictorialized representation of a system process. (5.2.2.4.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	TRANSILLUMINATED DISPLAYS
HF Considerations	Functionality (Cont.)
Abbreviation	Trans

Detailed Design Considerations	YES	NO	N/A	Comment
74. With the exception of aircrew station signals (MIL-STD-411) and training equipment (MIL-T-23991) transilluminated, LED and incandescent displays conform to the following color code: a) Flashing red denotes only emergency conditions which require operator action without undue delay to avert personnel injury and/or equipment damage. b) Red alerts an operator that a system or any of its parts is inoperative or that a successful mission is not possible unless corrective action is taken. c) Yellow advises an operator of a marginal condition or alerts him to situations of caution, recheck or unexpected delay. d) Green indicates that monitored equipment is in tolerance or that a state of readiness exists. e) White shows system conditions that do not have "right" or "wrong" implications such as alternating functions, except that white is not used in aircraft flight stations. f) Blue is used for advisory lights only, except that blue is not used in aircraft flight stations. (5.2.2.1.18)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	TRANSILLUMINATED DISPLAYS
HF Considerations	Location & Arrangement, Size & Shape
Abbreviation	Trans

Detailed Design Considerations	YES	NO	N / A	Comment
75. Indicator lights are immediately and unavoidably associated with the proper control. (5.2.2.1.6)				
76. On units with operator displays, maintenance displays are located behind access doors on the operator panel. (5.2.2.1.8)				
77. Viewing distance from the eye to the displays located close to controls is: 13 in. (330 mm) min., 25 in. (635 mm) max. (5.2.4.11, 5.2.4.12)				
78. Legend lights signifying danger are larger than other legend lights. (5.2.2.2.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	TRANSILLUMINATED DISPLAYS
HF Considerations	Visibility & Identification
Abbreviation	Trans

Detailed Design Considerations	YES	NO	N/A	Comment
79. In alternately-presented legends only one legend is clearly visible at a time. (5.2.2.2.6)				
80. In stacked legends: a) Front legends do not obscure rear legends. b) Parallax is minimized. c) Front and rear legends are equal in brightness and contrast with background. (5.2.2.2.6)				
81. Indicators are not exposed to direct or reflected light. (5.2.2.1.11)				
82. Lighted indicators used solely for maintenance and adjustment are not visible during normal operation but are readily accessible when required. (5.2.2.1.8)				
83. Luminance contrast within the indicator is at least 0.1. (5.2.2.1.12)				
84. The luminance of transilluminated displays is at least 10% greater than the surrounding luminance. (5.2.2.1.9)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	TRANSILLUMINATED DISPLAYS
HF Considerations	Use Conditions
Abbreviation	Trans

Detailed Design Considerations	YES	NO	N/A	Comment
85. Changes in display status represent the functional state of the system rather than the results of control activation alone. (5.2.2.1.4)				
86. Flashing lights have a flash rate of 3 to 5 flashes per second; in case of flasher failure, the light illuminates and burns steadily. (5.2.2.1.19)				
87. Lighted indicators incorporate filament redundancy or dual lamps. (5.2.2.1.13)				
88. Simultaneously active flashing lights have synchronized flashes. (5.2.2.1.19)				
89. Where glare must be reduced, the luminance of transilluminated displays does not exceed 300% of the surrounding luminance. (5.2.2.1.9)				
90. Indicators used at night can be dimmed [0.02 to 1.0 ft-L (0.07 to 3.5 cd/sq m)]. (5.2.2.1.10)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	SCALE INDICATORS
HF Considerations	Functionality, Location & Arrangement
Abbreviation	Scale

Detailed Design Considerations	YES	NO	N/A	Comment
91. The same numerical progression is used on all scales of combined displays. (5.2.3.2.1)				
92. Pointer tip is tapered at a 20° angle (40° included angle). (5.2.3.1.7.2)				
93. Scale pointers are tapered at the end terminating in a flat tip equal in width to the minor scale graduation. (5.2.3.1.7.2)				
94. There is an obvious break of at least 10° (175 mrad) of arc between the two ends of the scale, except on multirevolution instruments such as clocks. (5.2.3.2.3.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	SCALE INDICATORS
HF Considerations	Direction
Abbreviation	Scale

Detailed Design Considerations	YES	NO	N / A	Comment
95. For circular scales, alignment of pointer or fixed reference line is in the 12 o'clock position for right-left directional information and in the 9 o'clock position for up-down information. (5.2.3.2.3.5)				
96. For circular scales, alignment of pointer or fixed reference line is in the 12 o'clock position for right-left directional information and in the 9 o'clock position for up-down information. (5.2.3.3.3)				
97. For indicating a stable value, groups of indicators are arranged either in rows so all pointers line up horizontally or in columns so all pointers line up vertically. (5.2.3.2.4.5)				
98. If positive and negative values are displayed around a zero for all moving pointer displays but circular, magnitude of positive values increases with up or to the right movement of the pointer or magnitude of negative values increases with pointer movement down or to the left. (5.2.3.2.4.2)				
99. On fixed-pointer or moving scale indicators, numbers progress in magnitude in clockwise direction around the faces of circular dials. (5.2.3.3.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	SCALE INDICATORS
HF Considerations	Direction (Cont.)
Abbreviation	Scale

Detailed Design Considerations	YES	NO	N / A	Comment
100. On vertical or horizontal straight moving scales, numbers increase from bottom to top or from left to right. (5.2.3.3.1)				
101. The magnitude of positive values increases with a clockwise movement of a circular meter pointer; magnitude of negative values increases with a counterclockwise movement. (5.2.3.2.3.2)				
102. The magnitude of scale reading increases with clockwise movement of the pointer. (5.2.3.2.3.1)				
103. The magnitude of the scale reading increases with movement of the pointer up or to the right. (5.2.3.2.4.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	SCALE INDICATORS
HF Considerations	Visibility & Identification
Abbreviation	Scale

Detailed Design Considerations	YES	NO	N/A	Comment
104. Luminance contrast of at least 3.0 is provided between the scale face and the markings and pointer. (5.2.3.1.8)				
105. Pointer tail is the same color as the dial face, unless the tail is used as an indicator or the pointer is used for horizontal alignment. (5.2.3.1.7.4)				
106. Pointers are located to the right of vertical scales and at the bottom of horizontal scales. (5.2.3.2.4.3)				
107. The display pointer extends to, but does not obscure, the index mark width. (5.2.3.1.7.1)				
108. The display pointer is mounted as close as possible to the dial face to eliminate parallax and shadows. (5.2.3.1.7.3)				
109. The tip to the center of the dial part of a pointer is the same color as the marks. (5.2.3.1.7.4)				
110. There is a high degree of contrast between the scale face and markings. (5.2.3.1.8)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CATHODE RAY TUBE DISPLAYS
HF Considerations	Functionality, Location & Arrangement, Size & Shape
Abbreviation	CRT

Detailed Design Considerations	YES	NO	N/A	Comment
111. Control is provided to vary the CRT luminance from 10% of minimum ambient luminance to full CRT luminance. (5.2.4.3)				
112. Control is provided to vary the luminous symbol/dark background or dark symbol/luminous background contrast ratio. (5.2.4.3)				
113. Audio signals are not of an intensity or quality to create a disturbance. (5.3.4.2.1)				
114. A 16 in (400 mm) viewing distance is provided for CRTs. (5.2.4.2)				
115. When periods of scope observation are short, or when dim signals must be detected, minimum CRT viewing distance is 10 in (250 mm). (5.2.4.2)				
116. The target signal on a CRT does not subtend less than 20 minutes (6 mrad) of visual angle or less than 10 lines or resolution elements. (5.2.4.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CATHODE RAY TUBE DISPLAYS
HF Considerations	Visibility & Identification
Abbreviation	CRT

Detailed Design Considerations	YES	NO	N/A	Comment
117. If faint signal detection is required and ambient illumination is above 0.25 ft-c (2.7 lux), the CRT is hooded, shielded, or recessed. (5.2.4.4)				
118. The ambient illuminance does not contribute more than 25% of screen brightness through diffuse reflection and CRT phosphor excitation. (5.2.4.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	COMPUTER DISPLAY FORMATS
HF Considerations	Functionality, Location & Arrangement
Abbreviation	Format

Detailed Design Considerations	YES	NO	N/A	Comment
119. Essential data, text, and formats are under computer, not user, control. (5.15.3.1.1)				
120. Only data essential to the user's needs is displayed. (5.15.3.1.2)				
121. Data fields to be compared on a character-by-character basis are positioned one above the other. (5.15.3.1.8)				
122. When data fields have naturally occurring order (e.g., chronological), such order is reflected in the format organization of the fields. (5.15.3.1.4)				
123. When five or more alphanumeric characters without natural organization are displayed: a) The characters are grouped in blocks of three to five characters within each group. b) Separated by a minimum of one blank space or other separating character such as hyphen or slash. (5.15.3.1.7)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	**COMPUTER DISPLAY FORMATS**
HF Considerations	**Visibility & Identification**
Abbreviation	**Format**

Detailed Design Considerations	YES	NO	N / A	Comment
124. Data entry formats match the source document formats. (5.15.3.1.1)				
125. Data presented to the user is in a readily usable and readable form. (5.15.3.1.3)				
126. Display formats are consistent within a system. (5.15.3.1.1)				
127. Each display is labeled with a title or label that is unique within the system. (5.15.3.1.9)				
128. Each individual data group or message contains a descriptive title, phrase, word, or similar device to designate the content of the group or message. (5.15.3.1.10)				
129. Each page of a multiple page display is labeled to identify the currently displayed page and the total number of pages, e.g., Page 2 of 5. (5.15.3.1.12)				
130. Every display frame has a unique identification. (5.15.3.1.13)				
131. Every field or column heading in a display is labeled. (5.15.3.1.9)				
132. Items continued on the next page (scrolled) are numbered relative to the last item on the previous page. (5.15.3.1.11)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	COMPUTER DISPLAY FORMATS
HF Considerations	Visibility & Identification (Cont.)
Abbreviation	Format

Detailed Design Considerations	YES	NO	N/A	Comment
133. Recurring data fields within a system have: a) Consistent names. b) Consistent relative position within displays. (5.15.3.1.6)				
134. Separation of groups of information is accomplished by blanks, spacing, lines, color coding, or other means. (5.15.3.1.5)				
135. The frame identification is an alphanumeric code or an abbreviation which is prominently displayed in a consistent location. (5.15.3.1.13)				
136. The frame identification is short enough (3-7 characters) and/or meaningful enough to be learned and remembered easily. (5.15.3.1.13)				
137. When appropriate for users, the same format is used for input and output. (5.15.3.1.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	COMPUTER DISPLAY CONTENT
HF Considerations	Functionality, Visibility & Identification
Abbreviation	Content

Detailed Design Considerations	YES	NO	N/A	Comment
138. Definitions of all abbreviations, mnemonics, and codes are provided at the user's request. (5.15.3.2.3)				
139. Information is displayed in plain concise text. (5.15.3.2.3)				
140. The content of displays within a system is presented in a consistent, standardized manner. (5.15.3.2.1)				
141. A minimum of one character space is left blank vertically above and below critical information with a minimum of two character spaces left blank horizontally before and after. (5.15.3.2.2)				
142. Abbreviations and acronyms conform to MIL-STD-12, MIL-STD-411, or MIL-STD-783. (5.15.3.2.3)				
143. Abbreviations do not contain punctuation. (5.15.3.2.3)				
144. Information density is held to a minimum in displays used for critical task sequences. (5.15.3.2.2)				
145. Words have only one consistent abbreviation. (5.15.3.2.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	**COMPUTER DISPLAY CODING**
HF Considerations	**Functionality, Size & Shape**
Abbreviation	**Coding**

Detailed Design Considerations	YES	NO	N/A	Comment
146. Brightness intensity coding is employed only to differentiate between an item of information and adjacent information. (5.15.3.3.3)				
147. Coding is employed to: a) Differentiate between items of information. b) Call the user's attention to changes in the state of the system. (5.15.3.3.1)				
148. Consistent, meaningful codes are used. (5.15.3.3.1)				
149. Information is not coded solely by color if the data must be accessed from monochromatic as well as color terminals or printed in hardcopy versions. (5.15.3.3.7)				
150. Symbols are analogs of the event or system element they represent or are in general use and well known to the users. (5.15.3.3.6)				
151. Where size difference between symbols is employed, the major dimensions of the larger are at least 150 percent of the major dimension of the smaller with a maximum of three size levels permitted. (5.15.3.3.6)				

YES = Adequate **NO = Inadequate** **N/A = Not Applicable**

DESIGN CHECKLIST

Components	**COMPUTER DISPLAY CODING**
HF Considerations	**Visibility & Identification**
Abbreviation	**Coding**

Detailed Design Considerations	YES	NO	N/A	Comment
152. Coding does not reduce legibility or increase transmission time. (5.15.3.3.1)				
153. Each brightness level is separated from the nearest by at least a 2:1 ratio. (5.15.3.3.3)				
154. Flash coding is employed to call the user's attention to mission critical events only. (5.15.3.3.2)				
155. No more than two flash rates are used. (5.15.3.3.2)				
156. No more than three levels of brightness are used. (5.15.3.3.3)				
157. The colors selected do not conflict with the color association specified in TABLE II in MIL-STD-1472D. (5.15.3.3.7)				
158. Where one rate is used, the rate is between 3 and 5 flashes per second. (5.15.3.3.2)				
159. Where two rates are used in flash coding, the second rate is less than 2 per second. (5.15.3.3.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	DYNAMIC COMPUTER DISPLAYS
HF Considerations	Functionality, Visibility & Identification
Abbreviation	Dyn

Detailed Design Considerations	YES	NO	N/A	Comment
160. A display freeze mode is provided. (5.15.3.4.3)				
161. For frozen display frames, an option is provided to allow resumption at the point of stoppage or at the current real-time point. (5.15.3.4.3)				
162. The rate of update is controllable by the user. (5.15.3.4.2)				
163. An appropriate label is provided to remind the operator when the display is in the freeze mode. (5.15.3.4.4)				
164. Changing alphanumeric values which the operator must reliably read are not updated more often than once per second. (5.15.3.4.1)				
165. Changing values which the viewer uses to identify rate of change or to read gross values are not updated faster than 5 times per second nor slower than 2 per second when the display is to be considered as real time. (5.15.3.4.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	TABULAR DATA COMPUTER DISPLAYS
HF Considerations	Functionality, Location & Arrangement
Abbreviation	Tab

Detailed Design Considerations	YES	NO	N / A	Comment
166. Tabular data displays are used to present row-column data. (5.15.3.5.1)				
167. Alphanumeric data is left justified. (5.15.3.5.3)				
168. Location of recurring data is similar among all tabular data displayed and common throughout the system. (5.15.3.5.2)				
169. Tabular data is displayed in a left-to-right, top-to-bottom array. (5.15.3.5.3)				
170. Tabular displays do not extend over more than one page horizontally. (5.15.3.5.5)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	**TABULAR DATA COMPUTER DISPLAYS**
HF Considerations	**Visibility & Identification**
Abbreviation	**Tab**

Detailed Design Considerations	YES	NO	N/A	Comment
171. Conventional punctuation schemes are used if in common usage. Where none exist a space is used after every third or fourth digit. (5.15.3.5.7)				
172. Each item in a list starts on a new line. (5.15.3.5.6.1)				
173. Items in lists are arranged in a recognizable order, such as chronological, alphabetical, sequential, functional, or order of importance. (5.15.3.5.6)				
174. Leading zeros are not used in numerical data except where needed for clarity. (5.15.3.5.7)				
175. Long numeric fields are punctuated with spaces, commas, or slashes. (5.15.3.5.7)				
176. Numeric data is right justified with decimal points, if any, aligned vertically. (5.15.3.5.10)				
177. Strings of alphanumerics are grouped into sets of three to five characters or grouped at natural breaks. (5.15.3.5.8)				
178. When a code consists of both letters and digits, common character types are grouped by common character type for ease of location. (5.15.3.5.8)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	TABULAR DATA COMPUTER DISPLAYS
HF Considerations	Visibility & Identification (Cont.)
Abbreviation	Tab

Detailed Design Considerations	YES	NO	N/A	Comment
179. When tabular data are divided into classifications: a) The classification titles are displayed. b) Subclassifications are identified. (5.15.3.5.4)				
180. When tabular data extend over more than one page vertically, the columns are titled identically on each page. (5.15.3.5.4)				
181. When trend lines are to be compared, multiple lines are drawn on a single graph. (5.15.3.6.5)				
182. Where lists extend over more than one display page, the last line of one page is the first line of the succeeding page. (5.15.3.5.6.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	COMPUTER TEXT DISPLAYS
HF Considerations	Functionality, Visibility & Identification
Abbreviation	Text

Detailed Design Considerations	YES	NO	N/A	Comment
183. Display mode rather than line mode is used for text editing. (5.15.3.7.2)				
184. Text is displayed in normal upper/lower case front. (5.15.3.7.5)				
185. Textual data formats conform to the practices established for the particular type of textual data displayed (e.g., the format for display of specifications conforms to MIL-STD-490). (5.15.3.7.2)				
186. Paragraphs are numbered.				
187. Program lines reflect a numbering scheme for ease in editing and error correction. (5.15.3.7.4.2)				
188. Text paragraphs are separated by at least one blank line. (5.15.3.5.14)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LARGE SCREEN DISPLAYS
HF Considerations	Functionality
Abbreviation	Large

Detailed Design Considerations	YES	NO	N/A	Comment
189. A separate remote display is provided for operators who wish to make changes and receive information not of interest to the group. (5.2.5.5)				
190. Information presented on large screen group display systems is meaningful to trained observers without requiring reference to display control settings. (5.2.5.6)				
191. Large-screen displays are avoided when space and environmental conditions do not allow all critical operators to have visual access to the display in terms of viewing distance, angle, and lack of intervening objects, personnel, or ambient lighting. (5.2.5.2)				
192. Large-screen displays are used when one or more of the following conditions are true: a) A team of operators are sharing the same information. b) Team members must move about and still refer to information. c) Where it is not possible to provide each individual with commonly used information. d) To prevent disturbances resulting from looking over the shoulder(s) of individual operator(s) to see their individual displays. (5.2.5.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LARGE SCREEN DISPLAYS
HF Considerations	Functionality (Cont.)
Abbreviation	Large

Detailed Design Considerations	YES	NO	N/A	Comment
193. Projection display rates for group viewing conform to the limits of TABLE IV in MIL-STD-1472D. (5.2.6.6.2/3).				
194. Rear projection for large screen optical projection displays is used where physical obstructions to front projection prevent proper visibility or when work areas require high ambient illumination. (5.2.6.6.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LARGE SCREEN DISPLAYS
HF Considerations	Location & Arrangement, Size & Shape
Abbreviation	Large

Detailed Design Considerations	YES	NO	N/A	Comment
195. Large-screen displays are not closer to any observer than 1/2 the display width or height, whichever is greater. (5.2.5.3)				
196. Projector/screen arrangements which result in distortion of projected data are avoided. (5.2.6.6.5)				
197. Stroke width is 1/6 to 1/8 of numeral or letter height, but is narrower for light markings on a dark background. (5.2.6.6.4.1)				
198. Stroke width is the same for all letters and numerals of equal height. (5.2.6.6.4.1)				
199. The height of letters and numerals is not less than 15 minutes (4.5 mrad) of visual angle and in no instance is less than 10 minutes (3 mrad). (5.2.6.6.4.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LARGE SCREEN DISPLAYS
HF Considerations	Visibility & Identification
Abbreviation	Large

Detailed Design Considerations	YES	NO	N/A	Comment
200. A simple style of numerals and letters is used. (5.2.6.6.4.1)				
201. Capital letters are used, rather than lower case, except for extended copy or lengthy messages. (5.2.6.6.4.1)				
202. Colored markings on contrasting colored backgrounds of comparable brightness are avoided. (5.2.6.6.4.3.2)				
203. Contrast for optically projected displays is light on dark background or vice-versa, except where superposition is used. (5.2.6.6.4.3.2)				
204. For additive superposition (at the screen), contrast is light on opaque background. (5.2.6.6.4.3.2)				
205. For color photographs or black and-white photographs with grays, the minimum luminance ratio is 100:1. (5.2.6.6.4.3.1)				
206. For projections limited in shadows and detail, the minimum luminance ratio is 25:1. (5.2.6.6.4.3.1)				
207. For subtractive superposition (at the source), contrast is dark on transparent background. (5.2.6.6.4.3.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LARGE SCREEN DISPLAYS
HF Considerations	Visibility & Identification (Cont.)
Abbreviation	Large

Detailed Design Considerations	YES	NO	N/A	Comment
208. Large-screen displays are located so that the view of the display to critical observers is not obscured routinely by normal traffic patterns. (5.2.5.4)				
209. The luminance ratio for optically projected displays under optimal ambient lighting is 500:1. (5.2.6.6.4.3.1)				
210. The minimum luminance ratio for viewing charts, printed text, and other linework via slides or opaque projectors is 5:1. (5.2.6.6.4.3.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	**COUNTERS**
HF Considerations	**Functionality, Size & Shape, Direction & Force**
Abbreviation	**Counter**

Detailed Design Considerations	YES	NO	N/A	Comment
211. Counters are used for presenting quantitative data when continuous trend information is not required. (5.2.6.2.1)				
212. Counters and flags are mounted close to the panel surface. (5.2.6.2.2)				
213. Horizontal separation between numerals is between one-quarter and one-half the numeral width. (5.2.6.2.3)				
214. Movement relationships: a) Numbers change by snap action in preference to continuous movement. b) Numbers follow each other not faster than 2 per second when the observer is expected to read the numbers consecutively. c) The rotation of the counter reset knob is clockwise to increase the counter indication or to reset the counter. d) Counters used to indicate the sequencing of equipment is reset automatically upon completion of the sequence and provision is made for manual resetting. (5.2.6.2.4)				
215. Where pushbuttons are used to manually reset mechanical counters, actuating force required does not exceed 60 oz (16.7 N). (5.2.6.2.4)				

YES = Adequate **NO = Inadequate** **N/A = Not Applicable**

DESIGN CHECKLIST

Components	COUNTERS
HF Considerations	Visibility & Identification
Abbreviation	Counter

Detailed Design Considerations	YES	NO	N/A	Comment
216. Commas are not used. (5.2.6.2.3)				
217. Counters are horizontally positioned.				
218. Counters are self-illuminated when used in areas in which ambient illumination will provide display luminance below 1 ft-L (3.5 cd/sq m). (5.2.6.2.5)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	PRINTERS
HF Considerations	Functionality
Abbreviation	Print

Detailed Design Considerations	YES	NO	N/A	Comment
219. A take-up device for printed material is provided. (5.2.6.3.5)				
220. The user can obtain a paper copy of the exact contents of computer displays in systems where: a) Mass storage is restricted. b) Mass stored data can be lost by power interruption. c) Record keeping is required. (5.15.10.2)				
221. Information is not coded solely by color if the data must be accessed from monochromatic as well as color terminals or printed in hardcopy versions. (5.15.3.3.7)				
222. Material in printer is easily changed and indicates remaining supply of printing materials. (5.2.6.4.8)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	PRINTERS
HF Considerations	Visibilility & Identification
Abbreviation	Print

Detailed Design Considerations	YES	NO	N/A	Comment
223. If ambient illumination is inadequate, printed matter is illuminated by the printer. (5.2.6.3.4)				
224. Printed matter is readily visible. (5.2.6.4.2)				
225. Printed matter provides a minimum of 3.0 luminance contrast. (5.2.6.3.3)				
226. Printed output is free from character and line misregistrations, character tilt, and character smear. (5.2.6.3.7)				
227. Printed tape is printed so that it is directly readable as it is received without requiring the cutting and pasting of tape sections. (5.2.6.3.8)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	PLOTTERS AND RECORDERS
HF Considerations	Functionality, Visibility & Identification
Abbreviation	Plot Rec

Detailed Design Considerations	YES	NO	N / A	Comment
228. Plotters and recorders are used when a continuous visual record of graphic data is necessary. (5.2.6.4.1)				
229. Material in printer is easily changed and indicates remaining supply of printing materials. (5.2.6.4.8)				
230. Plotters and recorders provide positive feedback concerning the need for consumable replenishment. (5.2.6.4.8)				
231. A minimum of 1.0 luminance contrast is provided between the plotted function and the background on which it is drawn. (5.2.6.4.3)				
232. Plotters and recorders prevent pen assembly, arm, and other hardware elements from obscuring critical graphics while recording. (5.2.6.4.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	PLOTTERS AND RECORDERS
HF Considerations	Operating Procedures
Abbreviation	Plot Rec

Detailed Design Considerations	YES	NO	N / A	Comment
233. Graphic overlays do not obscure or distort the data. (5.2.6.4.5)				
234. Job aids (graphic overlays) are provided when a plotter operator is required to interpret graphic data. (5.2.6.4.5)				
235. Operational procedures, adjustments, and consumable replenishment for plotters, recorders are accomplished without requiring disassembly, special equipment, or tools. (5.2.6.4.8)				
236. Plotters and recorders are designed to allow operators to mark the paper while it is still in the plotter/recorder. (5.2.6.4.7)				
237. Plotters and recorders conform to the criteria regarding controls, displays, and operational components for machine operation and minor on-site maintenance. (5.2.6.4.8)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	FLAGS
HF Considerations	Functionality, Visibility & Identification
Abbreviation	Flag

Detailed Design Considerations	YES	NO	N / A	Comment
238. Flags are used to display qualitative, non-emergency conditions. (5.2.6.5.1)				
239. Indicator display malfunction is not indicated by positioning flags so as to obscure part of the operator's view of the malfunctioning display. (5.2.6.5.5)				
240. Flags are readily apparent under all levels of illumination. (5.2.6.5.5)				
241. When flag legends are used, lettering appears upright when the flag assumes the "no go" position. (5.2.6.5.6)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LEDS, DOT MATRIX & SEGMENTED DISPLAYS
HF Considerations	Functionality, Size & Shape
Abbreviation	LED

Detailed Design Considerations	YES	NO	N/A	Comment
242. Dot matrix and segmented displays are used for interactive computer systems, instruments, avionics, navigation, and communications equipment where alphanumeric, vector-graphic, symbolic, or real time information is required. (5.2.6.8.2)				
243. Dot matrix and segmented display alphanumeric and symbolic characters do not subtend less than 16 minutes (4.7 mrad) of visual angle. (5.2.6.8.4)				
244. Dot matrix displays are a minimum of 5 x 7 dots, with 7 x 9 dots preferred. (5.2.6.8.3)				
245. For applications requiring the presentation of alphanumeric, vector-graphic, symbolic or real-time information, dot matrix, 14-segment and 16-segment displays are used. (5.2.6.8.2)				
246. If the system requires symbol rotation, minimum specifications are 8 x 11 dots, with 15 x 21 dots preferred. (5.2.6.8.3)				
247. Seven segment displays are used only when presenting exclusively numeric information. (5.2.6.8.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LEDS, DOT MATRIX & SEGMENTED DISPLAYS
HF Considerations	Visibility & Identification
Abbreviation	LED

Detailed Design Considerations	YES	NO	N/A	Comment
248. Blue emitters are not used. (5.2.6.8.7)				
249. Dimming is compatible with that of incandescent displays. (5.2.6.7.3)				
250. Dot matrix, segmented, and electroluminescent displays use upper case alphanumeric characters. (5.2.6.8.5)				
251. Emitter colors for monochromatic displays use the following colors in order of preference: green (555 nm), yellow (575 nm), orange (585 nm), and red (660 nm). (5.2.6.8.7)				
252. LEDs are red only and not near red warning lights. (5.2.6.7.4)				
253. Optimum viewing angles for dot matrix and segmented displays are perpendicular to the display and not presented at an angle greater than 35° (0.61 rad) off axis. (5.2.6.8.6)				
254. Red LEDs/segmented displays are not grouped with or located adjacent to red warning lights. (5.2.6.8.10)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	ELECTROLUMINESCENT DISPLAYS
HF Considerations	Functionality, Size & Shape
Abbreviation	Electro

Detailed Design Considerations	YES	NO	N/A	Comment
255. Electroluminescent displays are used in conditions requiring the use of integrally lighted displays. (5.2.6.9.1)				
256. Electroluminescent displays are used when display reliability is critical. (5.2.6.9.1)				
257. Supplemental viewing system is provided for remote handling situations. (5.10.4.4)				
258. Alphanumeric characters for flight displays using dot matrix, segmented, or electroluminescent displays do not subtend less than 24 minutes (7 mrad) of visual angle. (5.2.6.9.2)				
259. Electroluminescent display alphanumeric and symbolic characters do not subtend less than 15 minutes (4.4 mrad) of visual angle. (5.2.6.9.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	COMPUTER AUDIO DISPLAYS
HF Considerations	Functionality
Abbreviation	Audio

Detailed Design Considerations	YES	NO	N/A	Comment
260. Audio signals used in conjunction with visual displays are: a) Supplementary to the visual signals. b) Used to alert and direct the user's attention to the appropriate visual display. (5.15.3.8.3)				
261. The intensity, duration, and source location of the signal is compatible with the acoustical environment of the intended receiver as well as the requirements of other personnel in the signal area. (5.3.3.2.1)				
262. Signals are intermittent. (5.15.3.8.4)				
263. Signals are automatically terminated by operator response action or by manual control. (5.15.3.8.4)				
264. Frequency of audio signals conforms to 5.3.3.1.1 of MIL-STD-1472D. (5.15.3.8.5)				
265. Audio design criteria follow 5.3.1, 5.3.2.1, and 5.3.2.3 of MIL-STD-1472D. (5.15.3.8.6)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	INTERACTIVE COMPUTER DISPLAYS
HF Considerations	Functionality, Visibility & Identification
Abbreviation	Interact

Detailed Design Considerations	YES	NO	N / A	Comment
266. An acknowledgement message is employed only in those cases where the more conventional mechanism is not appropriate or where feedback response time must exceed one second. (5.15.4.1.13)				
267. Except for broadcast communication systems, the transmitter of each message in inter-user communications is identified. (5.15.4.1.16)				
268. When numeric data is displayed or required for control input, such data is in the decimal, rather than binary, octal, hexa-decimal, or other number system. (5.15.4.1.10)				
269. Information necessary to select or enter a specific control action is available to the user when selection of that control action is appropriate. (5.15.4.1.5)				
270. The presence and location of control input data entered by the user is clearly indicated. (5.15.4.1.15)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	MENU SELECTION COMPUTER DISPLAYS
HF Considerations	Functionality, Visibility & Identification
Abbreviation	Menu

Detailed Design Considerations	YES	NO	N/A	Comment
271. If several levels of hierarchical menus are provided, a direct function call capability is provided. (5.15.4.2.8)				
272. Menus are presented in a consistent format throughout the system and are readily available at all times. (5.15.4.2.4)				
273. The system only presents menu selections for actions which are currently available. (5.15.4.2.3)				
274. Menu selections are listed in a logical order or, if no logical order exists, in the order of frequency of use. (5.15.4.2.5)				
275. When the number of selections can fit on one page in no more than two columns, a simple menu is used. (5.15.4.2.6)				
276. If menu selections must be made by keyed codes, the options are coded by the first several letters of their displayed labels. (5.15.4.2.11)				
277. Section codes and associated descriptors are presented on single lines. (5.15.4.2.7)				
278. When selections are indicated by coded entry, the code associated with each option is included on the display in some consistent manner. (5.15.4.2.10)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	FORM FILLING COMPUTER DISPLAYS
HF Considerations	Functionality
Abbreviation	Form

Detailed Design Considerations	YES	NO	N / A	Comment
279. A displayed cursor is positioned by the system at the first data entry field when the form is displayed. (5.15.4.3.6)				
280. Protected areas of the display areas are: a) Designated. b) Made inaccessible to the user via the cursor. (5.15.4.3.12)				
281. When a consistent dimensional unit is used in a given entry field, the dimensional unit is provided by the computer. (5.15.4.3.10)				
282. When required data entries have not been input: a) The omission is indicated to the user. b) Either immediate or delayed input of the missing items is allowed. (5.15.4.3.11)				
283. When the dimensional unit varies for a given field, it is provided, or selected, by the user. (5.15.4.3.10)				
284. Displayed forms are arranged such that related items are grouped together. (5.15.4.3.2)				
285. A standard input form is used. (5.15.4.3.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	FORM FILLING COMPUTER DISPLAYS
HF Considerations	Functionality (Cont.)
Abbreviation	Form

Detailed Design Considerations	YES	NO	N/A	Comment
286. Field labels are distinctively presented such that they can be distinguished from data entry. (5.15.4.3.5)				
287. Fields or groups of fields are separated by lines or other delineation cues. (5.15.4.3.4)				
288. Labels for data entry fields incorporate additional cueing of data format where the entry is made up of multiple inputs, e.g., DATE (M/D/Y): _____/_____/_____. (5.15.4.3.5)				
289. Required fields are distinguished from optional fields. (5.15.4.3.4)				
290. The format and content of displayed forms is perceptually related to that of paper forms if paper forms are used to guide data entry. (5.15.4.3.3)				
291. The maximum acceptable length for variable length fields is indicated. (5.15.4.3.7)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	COMPUTER FEEDBACK DISPLAYS
HF Considerations	Functionality
Abbreviation	Feedback

Detailed Design Considerations	YES	NO	N/A	Comment
292. Confirmation of user input occurs without removing the data display. (5.15.5.4)				
293. Feedback is provided to the user to provide status information. (5.15.5.1)				
294. Feedback is self explanatory. (5.15.5.7)				
295. If the system rejects user input, feedback is provided to indicate the reason for rejection and the required corrective action. (5.15.5.7)				
296. The information displayed to the user is limited to that which is necessary to perform specific actions or to make decisions. (5.15.4.6.2)				
297. When a control process or sequence is completed or aborted by the system, positive indication is presented to the user concerning the outcome of the process and the requirements for subsequent user action. (5.15.5.3)				
298. When multiple modes of operation exist, a means is provided to remind the user of the current mode. (5.15.5.5)				

YES = Adequate **NO = Inadequate** **N/A = Not Applicable**

DESIGN CHECKLIST

Components	COMPUTER FEEDBACK DISPLAYS
HF Considerations	Functionality (Cont.)
Abbreviation	Feedback

Detailed Design Considerations	YES	NO	N/A	Comment
299. When system functioning requires the user to stand-by, periodic feedback is provided to indicate normal system operation. (5.15.5.2)				
300. When a displayed message or datum is selected as an option or input to the system, the subject item is highlighted to indicate acknowledgment by the system. (5.15.5.6)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	COMPUTER PROMPTING DISPLAYS
HF Considerations	Functionality
Abbreviation	Prompt

Detailed Design Considerations	YES	NO	N/A	Comment
301. A dictionary of abbreviations and codes is available on-line. (5.15.6.5)				
302. Currently defined default values are displayed automatically in their appropriate data fields with the initiation of a data entry transaction. (5.15.7.1)				
303. On-line documentation, off-line documentation, and help instructions use consistent terminology. (5.15.6.6)				
304. Prompts and help instructions are used to explain commands, error messages, system capabilities, display formats, procedures, and sequences and to provide data. (5.15.6.1)				
305. Prompts and help instructions for system-controlled dialogue are explicit. (5.15.6.3)				
306. Prompts are clear and understandable. (5.15.6.4)				
307. Prompts do not require reference to coding schemes or conventions which may be unfamiliar to occasional users. (5.15.6.4)				
308. When operating in special modes, the system displays the mode designation and file(s) being processed. (5.15.6.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	COMPUTER PROMPTING DISPLAYS
HF Considerations	Location & Arrangement
Abbreviation	Prompt

Detailed Design Considerations	YES	NO	N / A	Comment
309. Prompting messages are displayed in a standardized area of the display. (5.15.6.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	COMPUTER ERROR CORRECTION DISPLAYS
HF Considerations	Functionality
Abbreviation	Error

Detailed Design Considerations	YES	NO	N/A	Comment
310. Error messages are constructive and neutral in tone. (5.15.8.5)				
311. The error messages reflect the user's view. (5.15.8.5)				
312. Computer-corrected commands, values, and spellings are displayed and highlighted for user confirmation. (5.15.8.9)				
313. To prompt for corrections of an error in stacked commands, the system displays the stacked sequence with the error highlighted. (5.15.8.10)				
314. Where control input errors are detected by the system, error messages are available and error recovery procedures are provided. (5.15.4.1.14)				
315. All error corrections by the user are acknowledged by the system, either by indicating a correct entry has been made or by another error message. (5.15.8.8)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

8. SPECIAL DISPLAYS

DESIGN CHECKLIST

Components	SPECIAL DISPLAYS
HF Considerations	Functionality, Location & Arrangement
Abbreviation	Function

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N/A	Comment
1. Displays such as cathode ray tube displays, head-up displays, collimated displays and other displays requiring refreshed information are updated in a synchronous manner. (5.2.1.3.10)				
2. For critical functions, indicators are located within 15° (265 mrad) of the operator's normal line of sight. See FIGURE 2 in MIL-STD-1472D. (5.2.2.1.7)				
3. Groups are located and arranged to share material, information, and equipment; to simplify supervision; and to simplify coordination. (5.14.2.2.2)				
4. Instruments are located so that, with glare shields and bezels in place, they can be easily read by appropriate crew members. (5.14.1.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	SPECIAL DISPLAYS
HF Considerations	Size & Shape
Abbreviation	Size

Detailed Design Considerations	YES	NO	N/A	Comment
5. Alphanumeric and symbolic characters do not subtend less than 16 min (4.7 mrad) of visual angle. (5.2.6.8.4)				
6. Alphanumeric characters are composed of upper case letters. (5.2.6.9.2)				
7. Flight display alphanumerics do not subtend less than 24 minutes (7 mrad) of visual angle. (5.2.6.9.2)				
8. Flight display characters which must be read under aircraft environmental conditions subtend not less than 24 min (7 mrad) of visual angle. (5.2.6.8.4)				
9. The height of alphanumeric characters and geometric and pictorial symbols do not subtend less than 15 minutes (4.5 mrad) of visual angle. (5.2.6.9.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	HEAD-UP DISPLAYS
HF Considerations	Functionality, Location & Arrangement
Abbreviation	HUD

Detailed Design Considerations	YES	NO	N/A	Comment
10. Head-up displays are compatible with the capabilities and limitations of the human visual system. (5.14.1.1.5.1)				
11. Head-up displays are refreshed to the degree of timeliness required by personnel in the normal operating mode. (5.2.1.3.10)				
12. Information presented on head-up displays is limited to critical data which the operator is required to monitor while simultaneously performing some primary visual task. (5.14.1.1.5.1)				
13. Aircraft display locations conform to requirements of MIL-STD-203, MIL-STD-250, MIL-STD-1333. (5.14.2.1)				
14. Aircraft advisory, caution and warning legends and signals conform to requirements of MIL-STD-411. (5.2.1.4.13)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	HEAD-UP DISPLAYS
HF Considerations	Size & Shape
Abbreviation	HUD

Detailed Design Considerations	YES	NO	N/A	Comment
15. Head-up displays have a minimum exit pupil (the area within a collimated beam in which the entire image formed by an objective lens is capable of being seen) of 2.8 in, (72 mm). (5.14.1.1.5.5)				
16. Head-up displays have a minimum field of view of 20° (350 mrad) in the vertical plane and 28° (490 mrad) in the horizontal plane. (5.14.1.1.5.4)				
17. Head-up display symbol line width is at least 3.4 ± 0.7 minutes (1.0 ± 0.2 mrad). (5.14.1.1.5.6)				
18. Symbols used in head-up displays have a minimum line width of 1.7 minutes (0.5 mrad). (5.14.1.1.5.6)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	HEAD-UP DISPLAYS
HF Considerations	Visibility & Identification
Abbreviation	HUD

Detailed Design Considerations	YES	NO	N/A	Comment
19. For most high ambient light applications, symbol brighiness is 2,000 - 3,000 Ft-L (6,900 - 10,300 cd/sq m). (5.14.1.1.5.2)				
20. Sufficient contrast is provided to ensure head-up display symbol legibility under all expected viewing conditions. (5.14.1.1.5.3)				
21. Symbol brightness is not less than 1500 Ft-L (5000 cd/sq m) when legibility in direct sunlight or background luminance of 10,000 Ft-L (34,000 cd/ sq m) is required. (5.14.1.1.5.2)				
22. Symbols are bright enough to be legible under all expected ambient lighting conditions. (5.14.1.1.5.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

9. COMMUNICATIONS

DESIGN CHECKLIST

Components	COMMUNICATIONS
HF Considerations	Functionality
Abbreviation	Function

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N/A	Comment
1. A foot-operated "Send Receive" control is provided for situations in which both hands are busy. (5.3.10.3)				
2. Circuits are designed so that the speaker hears his own voice in the headset in phase with his speech. (5.3.11)				
3. Communication equipment worn by an operator (head phones, telephone headsets, etc.) do not cause discomfort. (5.3.9.1)				
4. if communication channels are continuously monitored, each channel is provided with a signal-activated switching device (squelch control) to suppress channel noise during no-signal periods. (5.3.10.2)				
5. Microphone, headphone, and telephone headsets permit hands-free operation under normal working conditions. (5.3.9.2)				
6. The audio signal devices and circuit designs preclude false alarms. (5.3.1.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	COMMUNICATIONS
HF Considerations	Functionality (Cont.)
Abbreviation	Function

Detailed Design Considerations	YES	NO	N/A	Comment
7. The minimum setting of a volume control is limited to an audible level. (5.3.10.1)				
8. There is a positive feedback indicator that equipment is operative. (5.1.1.4)				
9. Whether audio warning signals are designed to be terminated automatically, by manual control, or both, an automatic reset function is provided. (5.3.6.2)				
10. If hand signals are used, crew members have unobstructed view of each other. (5.14.1.1.4)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	COMMUNICATIONS
HF Considerations	Location & Arrangement, Use Conditions
Abbreviation	Loc

Detailed Design Considerations	YES	NO	N/A	Comment
11. Communication devices are located within easy reach of operator.				
12. Radios and telephones are located for easy emergency access and time-critical communications.				
13. Reach to communication controls is unobstructed.				
14. Operations are possible wearing arctic mitts, arctic headwear.				
15. Workspace accommodates operators who are wearing earphones or headsets.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	COMMUNICATIONS
HF Considerations	Safety, Operating Procedures
Abbreviation	Safety

Detailed Design Considerations	YES	NO	N/A	Comment
16. Exposed metal parts are grounded. (5.13.7.1.5)				
17. Headsets worn in high ambient noise provide attenuation equal to ear protective device. (5.3.8.4)				
18. Radio antennas are located so as to minimize radio-frequency hazards.				
19. Antennas and waveguides are grounded.				
20. System allows emergency messages top priority and does not interfere with their transmission or reception. (5.3.5.6.2)				
21. Warning signal intensity does not cause discomfort or "ringing" in the ears. (5.3.3.2.3)				
22. Documentation includes standard communication procedures and protocol.				
23. Documentation provides instructions for use and fault detection for communications equipment.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	RECEPTION EQUIPMENT
HF Considerations	Functionality
Abbreviation	Recep

Detailed Design Considerations	YES	NO	N / A	Comment
24. Accessible volume or gain controls are provided for each communications channel. (5.3.10.1)				
25. Color coding is used when multiple handsets are visible or available to the operator. (5.3.9.3)				
26. Earphones and headsets are easily adjusted. (5.3.9.1)				
27. Headphones and loudspeakers respond uniformly (±5 dB) over the range 100 to 4,800 Hz. (5.3.8.1)				
28. Volume and gain controls for loudspeakers and headphones have sufficient electrical power to achieve at least 100 dB with two earphones. (5.3.10.1)				
29. When channel differentiation is required for three channels, one channel is left unfiltered, a high pass filter with 1,000 Hz cutoff is provided in the second channel, and a low-pass filter with 2,500 Hz cutoff is provided in the third channel. (5.3.8.2.2)				
30. When channel differentiation is required, apparent lateral separation is enhanced by applying low-pass filtering (frequency cutoff, FC = 1,800 Hz) to signals fed to loudspeakers on one side of the central operator position. (5.3.8.2.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	RECEPTION EQUIPMENT
HF Considerations	Location, Use Conditions, Safety
Abbreviation	Recep

Detailed Design Considerations	YES	NO	N / A	Comment
31. Loudspeakers used in multi-channel monitoring are mounted so that they are greater than 10° (175 mrad) apart radially in the horizontal plane with respect to the central operator's position. (5.3.8.2.1)				
32. Loudspeakers used in multi-channel monitoring are mounted so that they are greater than 45° (0.8 rad) apart radially to the left and the right of the central operator's position. (5.3.8.2.1)				
33. When several headsets are used, the most frequently or urgently needed headset is the most accessible. (5.3.9.3)				
34. Binaural headsets are used when ambient noise exceeds 85 dB(A). (5.3.8.4)				
35. When earphones will be worn in the operational situation, a dichotic presentation is used. (5.3.4.2.3)				
36. Metal parts of headsets do not come in contact with the user's skin. (5.3.9.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	TRANSMISSION EQUIPMENT
HF Considerations	Functionality
Abbreviation	Trans

Detailed Design Considerations	YES	NO	N / A	Comment
37. In environments of loud, low frequency noise (100 dB overall), noise-cancelling microphones are used providing at least a 10 dB RMS gain. (5.3.7.3)				
38. Microphone dynamic range, with a selected amplifier, is great enough to admit variations in signal input of at least 50 dB. (5.3.7.2)				
39. Microphones and associated system input devices respond to a speech spectrum of 200 to 6,100 Hz. (5.3.7.1)				
40. When no clipping is used, speech system input devices employ frequency pre-emphasis with a positive slope frequency characteristic no greater than 18 dB per octave from 140 to 1,500 Hz, and no greater than 9 dB per octave over the frequency range 1,500 to 4,800 Hz. (5.3.7.4)				
41. When the talker is in an intense noise field, the microphone is put in a noise shield. (5.3.7.6)				
42. When transmission equipment employs pre-emphasis and peak clipping is not used, reception equipment employs frequency de-emphasis. (5.3.8.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	TRANSMISSION EQUIPMENT
HF Considerations	Functionality (Cont.)
Abbreviation	Trans

Detailed Design Considerations	YES	NO	N/A	Comment
43. Where speech signals are to be transmitted over channels showing less than 15 dB peak speech to root-mean-square-noise ratios, peak clipping of 12 to 20 dB is employed at system input and is preceded by frequency pre-emphasis. (5.3.7.5)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	AUDIO SIGNALS
HF Considerations	Functionality
Abbreviation	Aud Sig

Detailed Design Considerations	YES	NO	N/A	Comment
44. A signal-to-noise ratio of at least 20 dB is provided in at least one octave band between 200 and 5,000 Hz at the operating position of the intended receiver. (5.3.4.1)				
45. Audio signals are coded as to maintenance, emergency, health hazard, signals. (5.3.4.3.2)				
46. Audio signals denoting emergencies are notably different from routine signals. (5.3.4.3.5)				
47. Audio warning signal duration is at least 0.5 second, and may continue until the appropriate response is made. (5.3.6.5)				
48. Completion of a corrective action by the operator, or by other means, automatically terminates the signal. (5.3.6.5)				
49. Critical warning signals are repeated with not more than a 3 second pause between messages. (5.3.5.6.1)				
50. Frequencies below 500 Hz are used when signals must bend around obstacles. (5.3.3.1.1)				
51. If absolute signal discrimination is required, the number of signals to be identified does not exceed four. (5.3.4.3.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	AUDIO SIGNALS
HF Considerations	Functionality (Cont.)
Abbreviation	Aud Sig

Detailed Design Considerations	YES	NO	N/A	Comment
52. If the operator is wearing earphones during normal operations, audio warning signals are directed to both earphones and to the work area. (5.3.4.2.4)				
53. The first 0.5 second of an audio signal is discriminable from the first 0.5 second of any other signal. (5.3.6.5)				
54. The following types of signals are not used as warning devices: a) Modulated or interrupted tones. b) Steady signals that resemble hisses, static, or sporadic radio signals. c) Trains of impulses that resemble electrical interference. d) Simple warbles. e) Scrambled speech effects. f) Signals that resemble random noise, periodic pulses, steady or frequency modulated simple tones, or countermeasure devices. g) Signals similar to random noise. (5.3.4.3.6)				
55. Audio warning signal frequency range is between: 200 - 5,000 Hz required 500 - 3,000 Hz preferred. (5.3.3.1.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	AUDIO SIGNALS
HF Considerations	Functionality (Cont.)
Abbreviation	Aud Sig

Detailed Design Considerations	YES	NO	N/A	Comment
56. The length of the warning is a minimum of 0.5 second until corrective action is taken. (5.3.4.3.3)				
57. The type of audible signal presented is in accordance with Table V in MIL-STD-1472D. (5.3.1.2)				
58. When reaction time is critical and a two element signal is used, all essential information is transmitted in the first 2.0 seconds of the identifying or action signals. (5.3.2.2.1)				
59. When reaction time is critical and a two element signal is used, an alerting signal of 0.5 second duration is provided. (5.3.2.2.1)				
60. When reaction time is critical, signals are of short duration. (5.3.2.2.2)				
61. Where a single element signal is used, all essential information is transmitted in the first 0.5 second. (5.3.2.2.2)				
62. When different audio signals are used to alert an operator to different conditions, discriminable differences in intensity, pitch, or use of beats and harmonics are provided. (5.3.4.3.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	AUDIO SIGNALS
HF Considerations	Functionality (Cont.)
Abbreviation	Aud Sig

Detailed Design Considerations	YES	NO	N/A	Comment
63. When signals must travel over 985 ft. (300 m), sounds with frequencies below 1,000 Hz are used. (5.3.3.1.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

10. LINES, HOSES & CABLES

DESIGN CHECKLIST

Components	LINES, HOSES & CABLES
HF Considerations	Functionality
Abbreviation	Function

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N/A	Comment
1. Cables are long enough to allow the functioning unit to be checked conveniently or extension cables are provided. (5.9.13.3)				
2. Guide pins or equivalent devices are provided to aid in alignment of drawer modules designed for "remove and replace" maintenance. (5.9.14.10)				
3. Plugs requiring no more than one turn, or other quick-disconnect plugs, are provided. (5.9.14.1)				
4. Covered space is provided for cable storage.				
5. Hand operation or common tools are used to tighten or loosen.				
6. Manner of connecting and disconnecting lines, hoses, cables is obvious.				
7. Reels and reel carts are provided to handle large, heavy, long lines and cables.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LINES, HOSES & CABLES
HF Considerations	Location & Arrangement, Size & Shape
Abbreviation	Loc

Detailed Design Considerations	YES	NO	N/A	Comment
8. Test cables terminating on control panels do not interfere with controls and displays. (5.9.13.4)				
9. Cables are routed so as to be accessible for maintenance and repair. (5.9.13.5)				
10. Number of inputs to and outputs from each unit are minimized by grouping functions.				
11. Bands, tags, and paints are placed adjacent to valves, regulators, flow checks, cleanouts, etc.; at the junction of branch lines; or where lines pass through walls and doors.				
12. Cable clamps are spaced every 12 in. (30 cm).				
13. Cables are size and shape coded for similar components. (5.9.13.8)				
14. Electrical plugs are size and shape coded. (5.9.14.3)				
15. Line fittings are standardized so that lines that differ in content are not interchangeable.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LINES, HOSES & CABLES
HF Considerations	Direction & Force, Clearance & Separation
Abbreviation	Dir

Detailed Design Considerations	YES	NO	N/A	Comment
16. Adequate space is provided to handle lines, hoses, and cables. (5.9.13.6)				
17. Cables are long enough so that drawer or slide-out racks can be opened without breaking electrical connections. (5.9.13.6)				
18. Clearance between cables and controls is 3 in. (76 mm) minimum.				
19. Tightening requires a clockwise motion; loosening requires a counterclockwise motion.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LINES, HOSES & CABLES
HF Considerations	Visibility & Identification
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N/A	Comment
20. Lines (pipe, hose, and tube) for liquids, gas, steam, etc., are clearly marked as follows: a) Function (hydraulic, electric, etc.). b) Subfunction, when required (flap up, flap down, etc.). c) Hazard. d) Direction of flow, if applicable. (5.13.3)				
21. Cables are labeled as to which equipment or connector they belong. (5.9.13.8)				
22. Cables are visible and accessible during maintenance. (5.9.13.5)				
23. Multiple conductors are coded every 12 inches (300 mm) along their length. (5.9.13.1)				
24. Identification tags and bands are used on: a) Cold lines or lines exposed to excessive heat (above 350 °F (163 °C)). b) Stainless steel lines 4 in. (101 mm) or longer.				
25. Identification paint is used on 4 in. (101 mm) minimum lines.				
26. Identification tapes encircle lines, hoses and cables.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LINES, HOSES & CABLES
HF Considerations	Visibility & Identification (Cont.)
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N / A	Comment
27. Coding conforms to requirements of MIL-STD-1247 and TABLES 5-2 and 5-3 of MIL-HDBK-759A(MI).				
28. Electrical cables are not routed below lines.				
29. If possible, individual conductors of all cables (either single or multi-conductor) are color-coded through their entire length.				
30. Line, hose, and cable color contrasts with background.				
31. At least one identification tape is visible from any point along the line.				
32. Low overhead pipes are highly visible.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LINES, HOSES & CABLES
HF Considerations	Use Conditions
Abbreviation	Use

Detailed Design Considerations	YES	NO	N/A	Comment
33. Cable, line, and hose connectors are operable by user wearing arctic mittens.				
34. Line and cable attachment parts are reachable by user in bulky clothing. (5.9.1.7)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LINES, HOSES & CABLES
HF Considerations	Safety
Abbreviation	Safety

Detailed Design Considerations	YES	NO	N / A	Comment
35. Cables are not pinched by doors or lids and are not in a position to be walked upon or used as handholds. They are not bent or twisted unnecessarily. (5.9.13.6)				
36. Cables routed through holes are protected by grommets, etc. (5.9.13.7)				
37. Automatic shutoffs are provided on fuel service equipment to prevent overflow or spillage. (5.13.7.3.2)				
38. Pipes and hoses are appropriately guarded in case temperature exceeds 140 °F (60 °C) or if it exceeds 120 °F (49 °C) during handling. (5.13.4.6)				
39. Pipes and hoses are appropriately guarded in case temperature is less than 32 °F (0 °C). (5.13.4.6)				
40. Long conductors and cables internal to the equipment are clamped to the chassis unless contained in wiring ducts or cable retractors. (5.9.13.2)				
41. Dangerous voltage is placarded. (5.13.2.1)				
42. Electrical wiring is routed away from lines carrying oxygen and flammable fluids.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	LINES, HOSES & CABLES
HF Considerations	Safety (Cont.)
Abbreviation	Safety

Detailed Design Considerations	YES	NO	N/A	Comment
43. High-pressure lines have a retaining chain attached to the line and source.				
44. Irregular, fragile, or awkward extensions are removable for handling.				
45. Conductors are bound into cables and held by lacing or tape.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

11. WORKSPACE

DESIGN CHECKLIST

Components	WORKSPACE
HF Considerations	Functionality, Size & Shape
Abbreviation	Function

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N/A	Comment
1. Adequate and suitable storage is provided for manuals, worksheets, etc. (5.7.1.3.4)				
2. Compartment design allows equipment sharing and reliable communication. (5.14.2.2.1)				
3. Design accommodates dimensions of 5th to 95th percentile soldier from FIGURES 23-29 and TABLES XIII-XVIII in MIL-STD-1472D. (5.6.1)				
4. Emergency procedures are detailed (5.14.3.1.1)				
5. Handles are provided on units which are removed or carried. (5.9.11.5.1)				
6. Instructions are kept simple. (5.14.3.1.1)				
7. Test stands are part of the equipment. (5.9.11.1)				
8. Sufficient space is provided to use test equipment and tools required during checkout. (5.9.4.3)				
9. Traffic flow between areas is efficient. (5.14.2.2.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	WORKSPACE
HF Considerations	Functionality (Cont.)
Abbreviation	Function

Detailed Design Considerations	YES	NO	N/A	Comment
10. Workspace allows ease of weapon handling, aiming, loading, firing, and field stripping. (5.14.1)				
11. Easy access to and from a station is provided.				
12. Equipment is designed and installed with workspace requirements in mind.				
13. User is oriented ɔ the work site.				
14. User space is not encroached on by others.				
15. Workspace provides head, arm, and body clearance at any weapon position.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	WORKSPACE
HF Considerations	Visibility & Identification
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N/A	Comment
16. Crane controls are easily reached and afford load visibility. (5.12.8.3)				
17. Windows, windshields, and canopies are free from color, distortion, etc. (5.14.1.1.1)				
18. The lines of sight to a display are not obscured by poor arrangement of people or equipment. (5.2.1.4.1)				
19. There is a direct view of work. (5.10.4.2)				
20. Areas requiring special equipment and/or clothing are specifically identified. (5.13.2.4)				
21. Push-out escape windows are marked.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	WORKSPACE
HF Considerations	Use Conditions
Abbreviation	Use

Detailed Design Considerations	YES	NO	N / A	Comment
22. Aerospace vehicle workspace clearances are sufficient for personnel wearing light or bulky clothing. (5.14.2.3).				
23. Allowances are made for heavy clothing and protective equipment. (5.7.4)				
24. Workspace accommodates required number of suitably clothed 95th percentile males. (5.7.4)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	WORKSPACE
HF Considerations	Safety
Abbreviation	Safety

Detailed Design Considerations	YES	NO	N/A	Comment
25. Any structure that can be chopped through in an emergency is clearly marked and axes are provided. (5.14.4.1.3)				
26. Equipment is secured in order to prevent accidental shifting or overturning. (5.14.4.1.4)				
27. Conspicuous placards are adjacent to equipment which is hazardous to the user. (5.13.2.1)				
28. Guards are provided on moving parts. (5.13.7.2.1)				
29. Hazard-alerting devices are provided. (5.13.4.1)				
30. Radiation exposure is below 0.5 milliroentgens per hr at a distance of two inches from any point on the external surface. (5.13.7.5)				
31. Radiation hazards from all sources are minimized. (5.13.7.5)				
32. Maintenance workspace is free of obstructions which could cause injury. (5.13.4.4)				
33. Manuals and markings include warnings on toxic and thermal hazards of heaters and exhaust gas.				
34. Padding is non-abrasive and non-toxic.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	WORKSPACE
HF Considerations	Safety (Cont.)
Abbreviation	Safety

Detailed Design Considerations	YES	NO	N/A	Comment
35. Exhausts are directed away from compartments.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONSOLES
HF Considerations	Location & Arrangement, Size & Shape
Abbreviation	Cons

Detailed Design Considerations	YES	NO	N/A	Comment
36. Components are located so that physical interference among operators working in the same areas is minimized. (5.14.2.2.1)				
37. Groups are located and arranged to share material, information, and equipment; simplify supervision and coordination. (5.14.2.2.2)				
38. Equipment is located to preclude awkward working positions.				
39. Exposed edges and corners are rounded and have a 0.03 in. (0.75 mm) minimum radius. (5.13.5.4)				
40. For personnel safety, edges and corners are rounded and have a 0.5 in. (13 mm) minimum radius. (5.13.5.4)				
41. Panel dimensions conform to TABLE XX and FIGURES 30-32 in MIL-STD-1472D. (5.7.5.1)				
42. Minimum extended lateral work-space for racks having drawers/ removable equipment is: Under 44 pounds (20 kg) 18 inches (460 mm) one side, 4 inches (100 mm) on the other. Over 44 pounds (20 kg) 18 inches (460 mm) on each side. (5.7.1.3.2)				
43. Right-left viewing angle for a wrap-around console is 190° (3.3 rad) maximum. (5.7.6.1.5)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONSOLES
HF Considerations	Clearance & Separation
Abbreviation	Cons

Detailed Design Considerations	YES	NO	N/A	Comment
44. Consoles and work surfaces that require standing or sitting close to the front surfaces has a kick space at least 4 in. (100 mm) in depth and height. (5.7.1.1)				
45. Consoles have at least 4 ft. (1.22 m) of free floor space in front. (5.7.1.3)				
46. The minimum space between rows of cabinets is 8 inches (200 mm) greater than the depth of the deepest drawer or cabinet. (5.7.1.3.3)				
47. Equipment racks requiring maintenance have a minimum distance from the front of the rack to the opposite surface or obstacle of 42 in. (1.070 m). (5.7.1.3.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	CONSOLES
HF Considerations	Visibility & Identification, Safety
Abbreviation	Cons

Detailed Design Considerations	YES	NO	N/A	Comment
48. Instrument reflection is avoided. (5.14.1.1.1)				
49. Display reading location is identified.				
50. Handles on cabinets and consoles are recessed whenever practicable, to eliminate projections on the surface. (5.7.1.2)				
51. Handles not recessed can neither injure personnel nor entangle clothing or equipment. (5.7.1.2)				
52. Protective padding is used.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	ILLUMINATION
HF Considerations	Visibility & Identification
Abbreviation	Illum

Detailed Design Considerations	YES	NO	N/A	Comment
53. Adequate illumination is provided in all areas. (5.13.4.5)				
54. Surface reflectance is per FIGURE 3-7 in MIL-HDBK-759A(MI). (5.8.2)				
55. Capability for light dimming is provided. (5.8.2)				
56. Illumination levels comply with TABLE XXI in MIL-STD-1472D. (5.8.2)				
57. Warning placards, stairways, and all hazardous areas are illuminated per TABLE XXI in MIL-STD-1472D. (5.13.4.5)				
58. Provisions for auxiliary power and lighting are provided.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	NOISE & VIBRATION
HF Considerations	Functionality
Abbreviation	Noise

Detailed Design Considerations	YES	NO	N/A	Comment
59. Maximum workspace noise limits: a) Extreme quiet needed: 35 dB(A). b) Telephone use or direct communication at distances up to 15 ft: 55 dB(A) SIL. c) Telephone use or direct communication at distances up to 5 ft: 55 dB(A). d) Small office spaces: 45 dB(A) SIL. e) General Workspaces: 75 dB(A) SIL. f) Shipboard: Conforms to MIL-STD-740-1, HEDGE FIGURE C-4. g) Aircraft: Conforms to MIL-A-8806. (5.8.3.3.1-6)				
60. Auditory alerting and warning signals are loud enough to be heard above environmental noise. (5.3.3.2.1)				
61. The acoustical environment does not degrade system effectiveness. (5.8.3.1)				
62. Sound absorption and attenuation material/layouts are provided. (5.8.3.4.2)				
63. Vibration exposure criteria are per FIGURE 43 in MIL-STD-1472D. (5.8.4.1.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	NOISE & VIBRATION
HF Considerations	Functionality (Cont.)
Abbreviation	Noise

Detailed Design Considerations	YES	NO	N/A	Comment
64. Facilities and equipment control transmission of whole body vibration to levels permitting safe operation and maintenance. (5.8.4.1.1)				
65. Motion sickness protection limits from exposure to vibration are per FIGURE 44 in MIL-STD-1472D. (5.8.4.1.1.4)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	HEATING & VENTILATION
HF Considerations	Functionality
Abbreviation	HV

Detailed Design Considerations	YES	NO	N/A	Comment
66. Adequate ventilation is provided at a minimum of 30 cu. ft. (0.85 cu.m) per minute per soldier. (5.8.1.2)				
67. Air moves past the operator at: 100 ft. (30 m) per minute max. 65 ft. (20 m) per minute preferred. (5.8.1.2)				
68. Wet bulb globe temperature conforms to the following: <u>Chemical protective clothing</u> 67°F (20°C) max. <u>Intermediate clothing</u> 70°F (21°C) max. <u>Use of body armor</u> 72°F (22°C) max. (5.8.1.8)				
69. If hard physical labor is sustained more than two hours, maximum wet bulb globe temperature is 77°F (25°C). See FIGURE 38 in MIL-STD-1472D. (5.8.1.8)				
70. The effective temperature within enclosures for extended periods is at or below 85°F (29°C). (5.8.1.3)				
71. Ventilation or other protective measures are provided within the limits of FIGURE 39 in MIL-STD-1472D. (5.8.1.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	HEATING & VENTILATION
HF Considerations	Use Conditions, Safety
Abbreviation	HV

Detailed Design Considerations	YES	NO	N/A	Comment
72. Air conditioning systems do not discharge cold air directly on personnel. (5.8.1.3)				
73. Arctic clothed soldier is not exposed to temperature greater than: 60°F (16°C) max., 35-45°F (2-7°C) optimum.				
74. Carbon monoxide is below levels that will result in carboxyhemoglobin (COHb) blood levels exceeding 5% (aviation systems), or 10% (all other systems). (5.13.7.4.2)				
75. Equipment is guarded if temperature exceeds 140°F (60°C). (5.13.4.6)				
76. Handled equipment is guarded if temperature exceeds 120°F (49 °C). (5.13.4.6)				
77. Handle or grasp surfaces are not thermally or electrically conductive. (5.9.11.5.7)				
78. Heating and air conditioning specifications: <u>Mobile work areas</u> 50 - 85°F (10 - 29°C) <u>Permanent work areas</u> 65 - 85°F (18 - 29°C) (5.8.1.1/3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	HEATING & VENTILATION
HF Considerations	Safety (Cont.)
Abbreviation	HV

Detailed Design Considerations	YES	NO	N/A	Comment
79. Intakes for ventilation systems are located so as to minimize the introduction of contaminated air from exhaust pipes, etc. (5.8.1.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	SEATING
HF Considerations	Functionality
Abbreviation	Seating

Detailed Design Considerations	YES	NO	N/A	Comment
80. Armrests do not interfere with work, egress, or emergency procedures. (5.14.2.4.7)				
81. Rotating seats have 8 locking positions minimum, and support 250 lb.(113 kg). (5.14.2.4.3)				
82. Seating is compatible with console (5.7.3.4.1)				
83. Standing operator has work surfaces provided to support manuals, etc. (5.7.2.1)				
84. The operator does not have to lift self to adjust the seat.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	SEATING
HF Considerations	Size & Shape
Abbreviation	Seating

Detailed Design Considerations	YES	NO	N/A	Comment
85. Armrests are at least 2 in. (50 mm) wide and 8 in. (200 mm) long. (5.7.3.4.5)				
86. Back and seat of chair have 1 in. (25 mm) minimum of padding. (5.7.3.4.4)				
87. Back-rest angle is less than 110° (1.9 rad) from horizontal. (5.7.3.4.3)				
88. Lateral work space is 30 in. (760 mm) wide x 16 in (406 mm) deep. (5.7.3.1/3)				
89. Writing space is 24 in. (610 mm) wide x 16 in. (406 mm) deep. (5.7.3.1/3)				
90. Seating providing only lumbar support possesses a back rest angle of 100 - 115° (1.7 - 2.0 rad) for alert positions. (5.7.3.4.3)				
91. Seat backrest reclines 103 to 115° (1.8 - 2.0 rad). (5.7.3.4.3)				
92. Seat backrest supports the torso so that the operator's eyes are within 3 in. (75 mm) of the "eye-line." (5.7.3.4.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	**SEATING**
HF Considerations	**Clearance & Separation**
Abbreviation	**Seating**

Detailed Design Considerations	YES	NO	N/A	Comment
93. Knee and foot room beneath work surfaces exceeds the following dimensions: Height 25 in. (640 mm) Width 20 in. (510 mm) Depth 18 in. (460 mm). (5.7.3.5)				
94. Vertical seat adjustibility is 15 to 21 in. (380 to 530 mm). (5.7.3.4.2)				
95. Vertical seat adjustments are in 1.0 in. (25 mm) increments maximum. (5.7.3.4.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	WORKSPACE IN VEHICLES
HF Considerations	Functionality
Abbreviation	in Veh

Detailed Design Considerations	YES	NO	N / A	Comment
96. Cars have seat belts. (5.12.2.7)				
97. The seated operator has free pedal access and use of foot pedals. (5.14.2.4.5)				
98. Fresh air is provided Minimum 20 cu. ft. (0.43 cu. m) per minute per person, Over 90°F (32°C) 150-200 cu. ft. (4.25-5.6 cu.m) per minute per person. (5.12.6.2)				
99. A 95th percentile loader with proper clothing can sit or stand clear of recoil while holding round. (9.1.8.7)				
100. Easy access to and from a station is provided.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	WORKSPACE IN VEHICLES
HF Considerations	Size & Shape
Abbreviation	In Veh

Detailed Design Considerations	YES	NO	N/A	Comment
101. A loader can comfortably sit in the closed-hatch mode or stand in the open-hatch mode.				
102. Armrests that are integral with operator's seats are at least 2 in. (50 mm) wide and 6 in. (200 mm) long. (5.14.2.4.7)				
103. Backrest angle is a maximum of 50° (875 mrad) for the rest position. (5.14.2.4.6)				
104. Backrest angle varies between 5 and 15° (85 and 260 mrad) aft of the vertical for the work position. (5.14.2.4.6)				
105. The rest angle does not exceed an included angle between seat and backrest of 136° (2.4 rad). (5.14.2.4.6)				
106. Passenger seats face the rear of the vehicle and include a 16 inch (400 mm) walkway space between the seat pan edge and the back of the adjacent seat. (5.14.2.4.9)				
107. Rotating seats adjust fore and aft at least 4 in. (100 mm) minimum. (5.14.2.4.3)				
108. Sitting surface provides a minimum of 9 in (230 mm) between the sitting surface and the bottom of the work surface. (5.14.2.4.4)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	WORKSPACE IN VEHICLES
HF Considerations	Size & Shape (Cont.)
Abbreviation	In Veh

Detailed Design Considerations	YES	NO	N/A	Comment
109. Armrests that are integral with operator's seats are 7.5 to 10 in (190 to 250 mm) above the seat surface. (5.14.2.4.7)				
110. Ceiling height of trailer vans and transportable enclosures is: <u>Standing</u> 78 in. (198 cm) <u>Seated</u> 74.5 in. (189 cm) (5.12.7.2)				
111. Aircraft seating conforms to requirements of MIL-STD-1333. (5.14.2.1)				
112. Vehicle operator seating conforms to requirements of TABLE XXVII and FIGURES 50-51 in MIL-STD-1472D.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	WORKSPACE IN VEHICLES
HF Considerations	Visibility & Identification
Abbreviation	In Veh

Detailed Design Considerations	YES	NO	N/A	Comment
113. Distortion is avoided in windows. (5.12.5.7)				
114. Door posts or wiper motors do not obscure vision.				
115. Loader can see outside while operating in closed-hatch mode.				
116. Mirrors are braced against vibration.				
117. Multireflections from multilayered windows are minimized. (5.14.1.1.2)				
118. Reflection of instruments or console in windows or windshields is avoided.				
119. The forward field of view is: 180° (3.1 rad) min., 220° (3.8 rad) preferred. (5.12.5.2)				
120. Truck operators are provided ground visibility for all distances beyond 10 ft. (3 m) in front of vehicle and upward visibility of 15° (.026 rad) above horizontal. Mirrors may be used to meet this requirement. (5.12.5.3)				
121. Visors reduce external glare. (5.12.5.6)				
122. Vision envelopes for aircraft conform to requirements of MIL-STD-850. (5.14.1.1.4)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	WORKSPACE IN VEHICLES
HF Considerations	Visibility & Identification (Cont.)
Abbreviation	In Veh

Detailed Design Considerations	YES	NO	N / A	Comment
123. Windscreen angle of incidence is 60° (1.05 rad). maximum for undistorted vision. (5.14.1.1.3)				
124. Windshields and windows are shatterproof and do not distort vision. (5.12.5.7)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	WORKSPACE IN VEHICLES
HF Considerations	Safety
Abbreviation	In Veh

Detailed Design Considerations	YES	NO	N/A	Comment
125. Emergency doors and exits are constructed so that they: a) Are simple to operate. b) Are readily accessible. c) Are unobstructed. d) Are simple to locate and operate in the dark. e) Are quick opening in three seconds or less. f) Require 10 to 30 lb (44 to 133 N) to open. g) Do not themselves constitute a safety hazard. h) Permit one person egress in 5 seconds or less. (5.13.4.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

12. FASTENERS & CONNECTORS

DESIGN CHECKLIST

Components	FASTENERS & CONNECTORS
HF Considerations	Functionality
Abbreviation	Function

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N/A	Comment
1. Access-cover fasteners are of the captive type. (5.9.10.3)				
2. Adapters for pin connectors can be hand-tightened. (5.9.14.12)				
3. Aligning pin extends beyond plug's electrical pins to insure alignment before electrical pins engage. (5.9.14.5)				
4. Captive type dust covers are used. (5.9.14.13)				
5. Design of plugs ensures that it is impossible to insert a wrong plug into a receptacle. (5.9.14.2)				
6. Fasteners are standardized to decrease the number of tools required. (5.9.10.5.3)				
7. Hinged doors or covers have captive, quick-opening fasteners. (5.9.10.3)				
8. Only standard tools are used. (5.9.14.12 - 5.9.10.1)				
9. Guide pins or equivalent devices are provided to aid in alignment of drawer modules designed for "remove and replace" maintenance. (5.9.14.10)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	**FASTENERS & CONNECTORS**
HF Considerations	**Functionality (Cont.)**
Abbreviation	**Function**

Detailed Design Considerations	YES	NO	N/A	Comment
10. Plugs and receptacles have aligning pins or equivalent devices for insertions. (5.9.14.4)				
11. Internal grip head fasteners are used only when a convex smooth surface is critical to mechanical function or for personnel safety. (5.9.10.5.2)				
12. Bolts have a minimum number of turns.				
13. Captive fasteners are used where dropping such items (nuts, bolts, etc.) may cause hazards or where access covers need frequent removal.				
14. Mounting bolts are semi-permanently captive.				
15. Mounting screws have clearance holes.				
16. Plugs and connectors are self-locking.				
17. Self-alignment is provided for fasteners.				
18. The number and type of fasteners used is minimized.				
19. There are not more fasteners or access panels than are required to maintain structural integrity of the unit.				

YES = Adequate **NO = Inadequate** **N/A = Not Applicable**

DESIGN CHECKLIST

Components	FASTENERS & CONNECTORS
HF Considerations	Location & Arrangement, Size & Shape
Abbreviation	Loc

Detailed Design Considerations	YES	NO	N/A	Comment
20. Plugs and receptacles are arranged so that aligning pins are oriented in the same relative position. (5.9.14.6)				
21. Connectors are placed so that spillage and weather do not cause damage.				
22. Bolts requiring high torque have an external grip head. (5.9.10.5.1)				
23. Non-interchangeable connectors are provided for different uses. (5.9.14.2)				
24. Connectors are physically different when lines carry different fluids. (5.13.7.3.1)				
25. Cotter keys have a snug fit and a large head.				
26. Fastener heads are large enough to be grasped and handled easily.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	FASTENERS & CONNECTORS
HF Considerations	Direction & Force
Abbreviation	Dir

Detailed Design Considerations	YES	NO	N/A	Comment
27. Fasteners and plugs require one turn maximum to tighten or to loosen. (5.9.14.1 - 5.9.10.7)				
28. Fasteners requiring less than 10 ft-lb.(14 N-m) of torque have hex type internal or external grip heads, or combination grip heads. (5.9.10.5.2)				
29. Fasteners requiring more than 10 ft-lb.(14 N-m) of torque possess a hex type external grip head. (5.9.10.5.1)				
30. For quick disconnect, snap action, release or twist, fasteners and plugs require up to one full turn for frequent critical use. (5.9.14.1 - 5.9.10.7)				
31. Tightening requires a clockwise motion; loosening requires a counterclockwise motion.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	FASTENERS & CONNECTORS
HF Considerations	Clearance & Separation
Abbreviation	Clear

Detailed Design Considerations	YES	NO	N/A	Comment
32. Adequate space is available to grasp connectors firmly. (5.9.14.8)				
33. Connectors are separated by at least 1.0 in. (25 mm)				
34. Where high torque is imposed, space is provided for use of a connector wrench. (5.9.14.8)				
35. Obstructions to access are removable.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	FASTENERS & CONNECTORS
HF Considerations	Visibility & Identification
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N/A	Comment
36. Connecting plugs and receptacles are identified by color, size or shape. See FIGURES 5.5 and 5.6 in MIL-HDBK-759A(MI). (5.9.14.3)				
37. Marking and color-coding of test-points conform to MIL-STD-415. (5.9.15.3)				
38. Plugs and receptacles have stripes, arrows, etc., to show aligning pin positions. (5.9.14.7)				
39. Receptacles are marked as to voltage, phase, and frequency. (5.13.26)				
40. Where torquing is imposed to meet special requirements, instruction labels or placards are provided in close proximity to fasteners. (5.9.10.8)				
41. Easy visual access is provided for starting threads.				
42. Fastener and connector operating parts are easily accessible and visible				
43. Identification colors are readily discriminable from each other under operational lighting.				
44. Labels and codes are visible when fastener is connected or not connected.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	FASTENERS & CONNECTORS
HF Considerations	Visibility & Identification (Cont.)
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N/A	Comment
45. Non-standard operating directions are clearly marked.				
46. Pins are size and color-coded to avoid mismatch.				
47. The manner of connection is obvious.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	FASTENERS & CONNECTORS
HF Considerations	Use Conditions
Abbreviation	Use

Detailed Design Considerations	YES	NO	N / A	Comment
48. Internal grip head fasteners are not used when exposed to outside elements (e.g., snow, ice, dirt). (5.9.10.5.2)				
49. Connectors are compatible with cables, lines, fasteners and mounting.				
50. Connectors are easily reached by user wearing bulky or restrictive clothing.				
51. Fastener heads are large enough to be grasped and handled with arctic mitts.				
52. Fasteners used outside are operable under all environmental conditions.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	FASTENERS & CONNECTORS
HF Considerations	Operating Procedures, Safety
Abbreviation	Op

Detailed Design Considerations	YES	NO	N/A	Comment
53. Connectors for handling toxic fluids are incompatible with other connectors within access. (5.13.7.3.1)				
54. All "hot" contacts are socket contacts. (5.13.7.1.3)				
55. Plugs and receptacles are such that a plug of one voltage rating cannot be inserted into the receptacle of another voltage rating. (5.13.7.1.2)				
56. Caps, inserts, covers, cases, and shields are provided where necessary.				
57. Removal of a plug or connector does not expose "hot" leads.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

13. HANDLES

DESIGN CHECKLIST

Components	HANDLES
HF Considerations	Functionality
Abbreviation	Function

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N/A	Comment
1. Non-fixed handles (hinges, fold-outs, etc.) have a stop-position for holding the handle perpendicular to the surface on which it is mounted. (5.9.11.5.3)				
2. Non-fixed handles are capable of being placed into position by one hand. (5.9.11.5.3)				
3. Removable and/or carried units are provided with handles or other suitable means for grasping, handling, and carrying. (5.9.11.5.1)				
4. Surface texture of hand manipulated fuse controls maximizes operator's grip. (5.9.11.5.4)				
5. Handles are provided to remove covers. (5.9.11.5.1)				
6. Handles guard against inadvertent control operation; protect meter face; and are used as support, standing, hanging, or locking devices.				
7. Handles, lugs, and push bars are permanent parts of the equipment case.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	HANDLES
HF Considerations	Functionality (Cont.)
Abbreviation	Function

Detailed Design Considerations	YES	NO	N/A	Comment
8. Hoist lugs are used if item weighs over 150 lb. (68 kg).				
9. Hand-shaped handles are used for items carried frequently or for long periods.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	HANDLES
HF Considerations	Location & Arrangement
Abbreviation	Loc

Detailed Design Considerations	YES	NO	N/A	Comment
10. Handles and grasp areas are located relative to the center of gravity of the unit. (5.9.11.5.2)				
11. Handles are located so that lifting is at a minimum distance from the body.				
12. Handles are on the front of an item if it is pulled from a rack.				
13. Handles do not interfere with operating or maintaining an item.				
14. Lift points on large items are equidistant from the center of gravity.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	HANDLES
HF Considerations	Direction & Force
Abbreviation	Dir

Detailed Design Considerations	YES	NO	N/A	Comment
15. Weight of item lifted by one soldier conforms to weight limits in Table XXIII in MIL-STD-1472D, conditions A and B. (5.9.11.3.1)				
16. Weight of item lifted by two soldiers conforms to double the weight limits in Table XXIII in MIL-STD-1472D. (5.9.11.3.1)				
17. Where three or more soldiers are lifting simultaneously, not more than 75% of the one-person value is added for each additional lifter. (5.9.11.3.1)				
18. If the frequency of lifting exceeds one lift in 5 minutes or 20 lifts per 8 hours, permissible weight limits in Table XXIII in MIL-STD-1472D are reduced by (8.33 x number of lifts per minute). (5.9.11.3.2)				
19. If the depth of a lifted object exceeds 24 inches (610 mm) the permissible weight in Table XXIII in MIL-STD-1472D is reduced by 33%. (5.9.11.3.3)				
20. If the depth of a lifted object exceeds 36 inches (910 mm), the permissible weight in Table XXIII in MIL-STD-1472D is reduced by 50%. (5.9.11.3.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	HANDLES
HF Considerations	Direction & Force (Cont.)
Abbreviation	Dir

Detailed Design Considerations	YES	NO	N/A	Comment
21. If the depth of a lifted object exceeds 48 inches (1.220 m), the permissible weight in Table XXIII in MIL-STD-1472D is reduced by 66%. (5.9.11.3.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	HANDLES
HF Considerations	Clearance & Separation
Abbreviation	Clear

Detailed Design Considerations	YES	NO	N/A	Comment
22. Handles have at least 2 in. (50 mm) clearance from obstructions. (5.9.11.5.2)				
23. Handles on cabinets and consoles are recessed wherever practicable. (5.7.1.2)				
24. If handles cannot be recessed, they are designed so that they can neither injure personnel nor entangle clothing or equipment. (5.7.1.2)				
25. Handle clearance and separation conform to the requirements of FIGURES 45 and 48 in MIL-STD-1472D. (5.9.11.5.5)				
26. Hoist lug has 4 in. (101 mm) minimum clearance around lifting eye.				
27. Straps and buckles do not interfere with operation of an item.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	HANDLES
HF Considerations	Visibility & Identification
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N/A	Comment
28. For mechanical power lifts and/or hoists, lift points are provided and labeled. (5.9.11.3.9)				
29. Hand-grasp areas are identified. (5.13.2.7)				
30. Handles are color-coded to distinguish from similarly shaped items.				
31. Handles are visible from the grasping and lifting positions.				
32. Hoist lugs are marked "Lift Here."				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	**HANDLES**
HF Considerations	**Use Conditions, Safety**
Abbreviation	**Use**

Detailed Design Considerations	YES	NO	N/A	Comment
33. Handles accommodate arctic mittens. (5.9.11.5.1)				
34. Collapsible handles can be erected while wearing arctic mittens. (5.9.11.5.1)				
35. Handles are reachable by 5th percentile personnel wearing bulky or restrictive clothing.				
36. Handgrips have non-slip surface. (5.9.11.5.4)				
37. Insulated handles are used on hot or conductive items. (5.9.11.5.7)				
38. Carried item will ride clear of the legs of personnel.				
39. Attachment screws of handles are recessed.				
40. Edges of handles are rounded.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

14. OPTICS

DESIGN CHECKLIST

Components	OPTICS
HF Considerations	Functionality
Abbreviation	Function

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N/A	Comment
1. Adjusted illumination level of illuminated reticle remains constant under intended use conditions. (5.11.3.12.4)				
2. Built-in collimation is provided for field adjustment. (5.11.3.18.4)				
3. Eyecups are provided to maintain proper eye relief, eliminate stray light, and protect or cushion the eyes and orbital region against impact. (5.11.3.14.1)				
4. Eyepiece focus adjustments over 4 power magnification are: -4 to +2 diopters required, -6 to +2 diopters desired. (5.11.3.9.2)				
5. Eyes do not have to adjust beyond normal functional ability. (5.11.3.2)				
6. Field of view is compatible with intended use and optical/mechanical limitations. (5.11.3.5)				
7. Field of view of illuminated reticle is uniformly illuminated. (5.11.3.12.5.)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	OPTICS
HF Considerations	Functionality (Cont.)
Abbreviation	Function

Detailed Design Considerations	YES	NO	N / A	Comment
8. For instruments 4-power and less, fixed focus eyepieces set between -0.50 and -1.00 diopter are utilized. (5.11.3.9.1)				
9. Illuminated reticle does not use blue light. (5.11.3.12.2)				
10. Illuminated reticle has provision for gradual dimming until light is extinguished. (5.11.3.12.3)				
11. Instrument magnification is sufficient for the required operator task. (5.11.3.4.1)				
12. Instruments over 4-power have eyepiece focus adjustments marked in 0.5 diopter increments. (5.11.3.9.2)				
13. Line reticles are provided as opposed to those with 1, 2, or 3 central spots. (5.11.3.11.3)				
14. Magnification difference between the two eyes is 2% maximum. (5.11.3.13.3)				
15. Optical instruments are oriented to give the operator a comfortable angle of view. (5.11.3.3)				
16. Reticle provides a small cross or circle as opposed to a dot. (5.11.3.11.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	OPTICS
HF Considerations	Functionality (Cont.)
Abbreviation	Function

Detailed Design Considerations	YES	NO	N/A	Comment
17. Weight of handheld binocular device does not exceed: 2.2 lb. (1.0 kg) preferred, 3.3 lb. (1.5 kg) max. (5.11.3.13.6)				
18. Where components require frequent maintenance, provision is made for storage of replacement parts and special tools. (5.11.3.18.6)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	OPTICS
HF Considerations	Location & Arrangement
Abbreviation	Loc

Detailed Design Considerations	YES	NO	N/A	Comment
19. Components requiring frequent maintenance and frequently used special tools are readily accessible. (5.11.3.18.6)				
20. Purging and charging fittings are accessible for maintenance. (5.11.3.18.5)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	OPTICS
HF Considerations	Size & Shape
Abbreviation	Size

Detailed Design Considerations	YES	NO	N/A	Comment
21. Entrance pupil is equal to the product of the magnification and the exit pupil diameter. (5.11.3.6)				
22. Exit pupil diameter is: Daylight conditions 0.12 in. (3mm) Twilight/low light conditions 0.28 in. (7 mm). (5.11.3.7.2, 5.11.3.7.3)				
23. Exit pupil diameter is consistent with intended use and size/weight limitations. (5.11.3.7.1)				
24. Eye relief for recoilless systems is at least 0.6 in. (15 mm). (5.11.3.8)				
25. Eye relief for vehicle mounted sights is at least 1.0 in. (25 mm). (5.11.3.8)				
26. Eyepiece and eyecup dimensions conform to FIGURE 49 in MIL-STD-1472D. (5.11.3.14.1)				
27. Reticle line thickness for illuminated reticle subtends visual angle of: 0.5 min. (150 microrad) min., 2.0 min. (600 microrad) preferred. (5.11.3.12.6)				
28. Reticle lines are thin enough not to block targets and thick enough to be easily seen. (5.11.3.11.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	OPTICS
HF Considerations	Direction & Force, Separation
Abbreviation	Dir

Detailed Design Considerations	YES	NO	N/A	Comment
29. Boresight knob locks do not require more than 10 lb. (45 N) resistance to lock and unlock. (5.11.3.18.7.2)				
30. Eyepiece separation for binocular instruments is adjustable from 2.0 in. to 2.9 in. (50 to 73 mm). (5.11.3.13.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	OPTICS
HF Considerations	Visibility, Use Conditions, Safety
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N / A	Comment
31. Difference between the two eyes in luminous transmittance is 5% maximum. (5.11.3.13.4)				
32. Magnification of rifle or pistol sight is 4 power maximum monocular or 8 power maximum binocular. (5.11.3.4.2)				
33. Eyecups and headrests are compatible with helmets, masks, and other personal equipment. (5.11.3.14.3)				
34. Illuminated reticle is provided for use during twilight or night conditions. (5.11.3.12.1)				
35. Optic components accommodate arctic headwear, handwear. (5.11.3.14.3)				
36. Two eyepieces are used during low light level viewing that exceeds one minute in duration. (5.11.3.13.1)				
37. There is no skin contact with metal parts.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

15. OPERATING ELEMENTS

DESIGN CHECKLIST

Components	OPERATING ELEMENTS
HF Considerations	Functionality
Abbreviation	Function

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N/A	Comment
1. Self-alignment devices are provided for remotely handled items. (5.10.1.1)				
2. Gunner environment minimizes obscuration, shock, and vibration to permit resumption of tracking after firing, when applicable. (5.11.2.1)				
3. A single control, joystick, or ball is used for two-dimensional tracking. (5.11.2.3)				
4. Boresight knobs have positive lock. (5.11.3.18.7.1)				
5. Hoist points are provided for mechanical lifting. (5.9.11.3.9)				
6. Controls, vents, etc. are easily and safely accessible during setup and operation.				
7. Tiedown points are accessible before, during, and after transit.				
8. Tiedown and handling points allow free passage of line, cable, and/or hook.				
9. Manual turret traverse travel is 360° and can be pitched or canted.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	OPERATING ELEMENTS
HF Considerations	Functionality (Cont.)
Abbreviation	Function

Detailed Design Considerations	YES	NO	N/A	Comment
10. Loading elements are sized for load.				
11. Weapon is operable under difficult conditions of weather, clothing, temperature, terrain, climate, or illumination.				
12. Power gun control system allows selective use of manual or power control.				
13. Air-dropped items have quick release capability.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	OPERATING ELEMENTS
HF Considerations	Location and Arrangement, Size and Shape
Abbreviation	Loc

Detailed Design Considerations	YES	NO	N/A	Comment
14. Rifle and machine gun dimensions conform to FIGURE 7-2 in MIL-HDBK-759A(MI).				
15. Tracking crank size is a function of rotation speed (200 rpm max.). (5.11.2.2)				
16. Tracking crank radius for high rpm is 2.2 in. (55 mm); for low rpm it is 4.5 in. (115 mm). (5.11.2.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	OPERATING ELEMENTS
HF Considerations	Direction & Force
Abbreviation	Dir

Detailed Design Considerations	YES	NO	N/A	Comment
17. Boresight knob lock resistance to lock or unlock is 10 lb. (4.5 kg) max. (5.11.3.18.7.2)				
18. Triggers, safeties, and arming pins need a positive force to operate and are operable by 5th percentile user.				
19. Foot pedals rise from a depressed position backwards and vertically.				
20. Power controller has: Backlash 0, Dead band ± 2° (35 mrad), Operating torque 5 lb. (2.3 kg).				
21. Recoil or stress of field maneuvering does not disturb bipod's extended/retracted setting.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	OPERATING ELEMENTS
HF Considerations	Clearance & Separation
Abbreviation	Clear

Detailed Design Considerations	YES	NO	N / A	Comment
22. Units frequently pulled out of installed position are mounted on pullout racks, slides, or hinges. (5.9.12.6)				
23. Full hand and tool clearance is provided at all fastening points.				
24. Moving components have 2 in. (50 mm) hand clearance throughout range.				
25. Trigger guards, safety catches, etc., accommodate gloved hands.				
26. Retracted bipod cannot catch on vegetation.				
27. Lift and attachment points are accessible and are equidistant from center of gravity.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	OPERATING ELEMENTS
HF Considerations	Visibility & Identification
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N/A	Comment
28. Controls used only for maintenance or adjustment are covered during normal operation, but are accessible and visible when required. (5.4.1.3.6)				
29. Tiedown points are visible for checking.				
30. Blind feed of hooks or cables is avoided.				
31. Tiedown or handling point is emphasized by contrasting color or a label.				
32. Operated elements are visible when accessed, especially if hazards are present.				
33. Elements that are mated are color- or shape-coded.				
34. Settings can be verified in normal firing position without moving body/weapon, manipulating any sight component, or counting of visual/auditory cues.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	OPERATING ELEMENTS
HF Considerations	Use Conditions
Abbreviation	Use

Detailed Design Considerations	YES	NO	N/A	Comment
35. Power manipulators are provided with positive stops. (5.10.3.1)				
36. Joysticks used for tracking have hand and wrist support. (5.11.2.4)				
37. Tracking control movement is compatible with expected and conventional control movements. (5.11.2.5)				
38. Operating elements accommodate arctic handwear. (5.4.1.6)				
39. Foot controls are not used for precise adjustments. (5.4.1.8.6.2)				
40. Knobs are used as opposed to screwdriver for frequent adjustment. (5.9.3.1)				
41. Handwheels are knurled or indented.				
42. Weapons controls have distinctive shapes and/or locations.				
43. Sight-mount leveling vial supports are strong enough to prevent bubble displacement.				
44. Parts cannot be assembled backwards.				
45. Weapon settings are immediately obvious with user in normal firing position.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	OPERATING ELEMENTS
HF Considerations	Use Conditions (Cont.)
Abbreviation	Use

Detailed Design Considerations	YES	NO	N/A	Comment
46. Weapon controls are sturdy enough so that normal field handling cannot damage them.				
47. Jack and hoist points are labeled.				
48. Rate selectors, safeties, etc. are clearly identified as to their position.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	OPERATING ELEMENTS
HF Considerations	Safety
Abbreviation	Safety

Detailed Design Considerations	YES	NO	N/A	Comment
49. Internal controls are not located near high voltage, rotating machinery, or other hazards. (5.9.3.6)				
50. Use of pullouts does not shift center of gravity of item to the extent that the entire rack console falls. (5.9.12.6)				
51. Rollouts are provided with limit stops. (5.9.12.7)				
52. Safety is operable without removing hand from weapon.				
53. Any part of weapon that contacts user's skin has thermal insulation.				
54. Safety catches have a distinctive shape and location.				
55. Weapon ejects expended cases forward and to the right.				
56. Projections, edges, and corners around tiedown or lift points are rounded, padded or eliminated.				
57. Electrical, thermal or mechanical hazards near location where user's hand must access are shielded.				
58. Safety catches have positive action and standard operation.				
59. Mechanical operating parts are guarded.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	OPERATING ELEMENTS
HF Considerations	Operating Procedures
Abbreviation	Op

Detailed Design Considerations	YES	NO	N / A	Comment
60. Center of gravity and weight of equipment is marked, where applicable. (5.13.2.2)				
61. Weight capacity is indicated on all lifting equipment. (5.13.2.3)				
62. Diagrammed instructions accompany item to provide for adequate tiedown.				
63. Magazine loading is diagrammed if a particular pattern is required.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

16. PACKAGING

DESIGN CHECKLIST

Components	PACKAGING
HF Considerations	Functionality
Abbreviation	Function

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N/A	Comment
1. Guides, tracks, and stops are used to facilitate handling. (5.9.7.4)				
2. Special opening tools are avoided. (5.9.10.1)				
3. Stowage is available for individual weapons, small-arms ammunition rations, helmets, etc.				
4. Stowage is available for rations.				
5. Tools for opening are built-in or attached to containers.				
6. Tools and devices that are carried, fold or collapse so that they require minimum carrying space.				
7. Small packages are sized for packets and are relatively flat.				
8. Catches and fasteners lock and unlock easily.				
9. Tools, tabs, etc., are large enough for full hand or finger grasp and force application.				
10. Tight-fitting stowage is avoided.				
11. Sealed cans have integral opener device, strip, or tab.				
12. Missiles are easily stowed in racks.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	PACKAGING
HF Considerations	Location and Arrangement, Size & Shape
Abbreviation	Loc

Detailed Design Considerations	YES	NO	N / A	Comment
13. Accessibility of stowed equipment reflects its function and use.				
14. Stowage boxes are part of the vehicle, rather than attachments to it.				
15. Cases are sufficiently larger than the units they cover to minimize the possibility of damaging wires or other components when cases are put on or taken off. (5.9.7.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	PACKAGING
HF Considerations	Direction & Force
Abbreviation	Dir

Detailed Design Considerations	YES	NO	N / A	Comment
16. Weight of item lifted by one soldier conforms to weight limits in Table XXIII in MIL-STD-1472D, conditions A and B. (5.9.11.3.1)				
17. Weight of item lifted by two soldiers conforms to double the weight limits in Table XXIII in MIL-STD-1472D.(5.9.11.3.1)				
18. Where three or more soldiers are lifting simultaneously, not more than 75% of the one-person value is added for each additional lifter. (5.9.11.3.1)				
19. If the frequency of lifting exceeds one lift in 5 minutes or 20 lifts per 8 hours, permissible weight limits in Table XXIII in MIL-STD-1472D are reduced by (8.33 x number of lifts per minute). (5.9.11.3.2)				
20. If the depth of a lifted object exceeds 24 inches (610 mm) the permissible weight in Table XXIII in MIL-STD-1472D is reduced by 33%. (5.9.11.3.3)				
21. If the depth of a lifted object exceeds 36 inches (910 mm), the permissible weight in Table XXIII in MIL-STD-1472D is reduced by 50%. (5.9.11.3.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	PACKAGING
HF Considerations	Direction & Force (Cont.)
Abbreviation	Dir

Detailed Design Considerations	YES	NO	N/A	Comment
22. If the depth of a lifted object exceeds 48 inches (1.220 m), the permissible weight in Table XXIII in MIL-STD-1472D is reduced by 66%. (5.9.11.3.3)				
23. Missile rack latches are set for quick release and have a 12 lb. (5.4 kg) force maximum.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	PACKAGING
HF Considerations	Clearance & Separation
Abbreviation	Clear

Detailed Design Considerations	YES	NO	N/A	Comment
24. Bulkheads, brackets, or other units do not interfere with opening or removal of covers on units within which work is done.(5.9.8.3)				
25. Containers allow for full hand and finger clearance when using opening tool.				
26. Gloved hand clearance is provided.				
27. Vertically mounted missiles exceeding 40 lb. (18 kg) have floor retainer with enough clearance for 95th percentile hand.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	**PACKAGING**
HF Considerations	**Visibility & Identification, Use Conditions**
Abbreviation	**Vis**

Detailed Design Considerations	YES	NO	N / A	Comment
28. Identification of package contents is clearly visible.				
29. Cases lift from units rather than units lift from cases. (5.9.7.2)				
30. It is obvious when a cover is in place but not secured. (5.9.8.1)				
31. Tabs and grasp points for opening are clearly identifiable. (5.13.2.7)				
32. For cross-country operations, items are secured in stowage boxes or restrained by straps or brackets.				
33. The materiel remaining is easily determined.				

YES = Adequate **NO = Inadequate** **N/A = Not Applicable**

DESIGN CHECKLIST

Components	PACKAGING
HF Considerations	Safety, Operating Procedures
Abbreviation	Safety

Detailed Design Considerations	YES	NO	N/A	Comment
34. Flammable items are stowed away from engines, generators and exhaust pipes.				
35. Edges and corners on covers and cases are rounded or otherwise finished to prevent personnel injury.				
36. Glass containers are avoided for field use.				
37. Labels warn of hazards and dangers within case.				
38. Plug-in components are used where feasible. Incorrect installation of a plug-in unit is prevented by virtue of its size, shape, etc.				
39. Orientation of a unit within its case is obvious or labeled. (5.9.7.1)				
40. Instructions for opening a cover are permanently displayed if opening is not obvious. (5.9.8.2)				
41. Labels/markings tell how to open and remove position covers and cases.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

17. ACCESSES, COVERS & CAPS

DESIGN CHECKLIST

Components	ACCESSES, COVERS & CAPS
HF Considerations	Functionality
Abbreviation	Function

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N / A	Comment
1. Access covers are equipped with grasp areas for opening. (5.9.9.5.1.1)				
2. An access is provided when frequent maintenance would require removing a case or cover or dismantling a component. (5.9.9.1)				
3. Captive fasteners are used when periodic removal is required. (5.9.10.3)				
4. Covers which are not completely removable are self-supporting in the open position. (5.9.9.2)				
5. Replaceable caps are of the captive type. (5.9.14.13)				
6. Sliding, rotating, or hinged units open fully and remain in place without hand support. (5.9.4.4)				
7. The number of screws used to hold accesses closed is minimized. (5.9.10.4)				
8. Sliding doors and caps lock positively.				
9. Cover fasteners self-lock for closing with an audible snap.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	ACCESSES, COVERS & CAPS
HF Considerations	Functionality
Abbreviation	Function

Detailed Design Considerations	YES	NO	N / A	Comment
10. Small covers hinge at bottom and open down.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	ACCESSES, COVERS & CAPS
HF Considerations	Location & Arrangement, Size & Shape
Abbreviation	Loc

Detailed Design Considerations	YES	NO	N/A	Comment
11. Replaceable items are not placed in a manner which makes them difficult to remove. (5.9.4.1)				
12. Bulkheads and brackets do not interfere with opening or removing covers. (5.9.8.3)				
13. Rubber stripping or sealing material is located so user will not damage it when the cover is removed.				
14. Access opening size and shape conform to the requirements of FIGURE 45 in MIL-STD-1472D. (5.9.9.5.1.2)				
15. Caps are large enough to be handled with gloves. (5.9.1.7)				
16. Opening size allows adequate visual access. (5.9.9.5.1)				
17. Openings are large enough to permit required operations. (5.9.9.5.1)				
18. Container opening is large enough to allow full entry and passage of measuring utensils.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	ACCESSES, COVERS & CAPS
HF Considerations	Direction & Force, Clearance & Separation
Abbreviation	Dir

Detailed Design Considerations	YES	NO	N/A	Comment
19. One soldier can lift cover. (5.9.11.3.1.1)				
20. Caps tighten clockwise and loosen counterclockwise.				
21. Latch cover requires positive force to open.				
22. Access is large enough to insert arm, hand, tools, and/or test equipment. (5.9.9.5.1.2)				
23. Covers through which mounting screws pass for attachment have holes large enough to permit screws to pass without perfect alignment. (5.9.6)				
24. Structural members of units do not prevent removal of components. (5.9.4.1)				
25. Open covers do not interfere with controls or displays.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	ACCESSES, COVERS & CAPS
HF Considerations	Visibility & Identification
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N/A	Comment
26. Cover opening method is obvious or instructions are displayed on outside of cover. (5.9.8.2)				
27. Instructions are visible when access cover is open. (5.9.9.3)				
28. It is obvious when a cover is in place but not secured. (5.9.8.1)				
29. Labels and instructions are properly oriented when cover, case, or door is open. (5.9.9.3)				
30. Labels indicate function of units behind enclosure access. (5.9.9.3)				
31. Labels indicate how service equipment is oriented or connected. (5.9.9.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	ACCESSES, COVERS & CAPS
HF Considerations	Visibility & Identification (Cont.)
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N/A	Comment
32. Where visual access is required, one of the following is provided (most preferable first). a) An opening with no cover except where this might degrade system performance. b) A transparent window if dirt, moisture, or other foreign materials might create a problem. c) A break resistant glass window if physical wear, heat, or contact with solvents would otherwise cause optical deterioration. d) A quick opening metal cover if glass will not meet stress or other requirements. (5.9.9.6)				
33. While operator performs tasks, openings are large enough for internal components to be visible. (5.9.9.5.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	**ACCESSES, COVERS & CAPS**
HF Considerations	**Use Conditions**
Abbreviation	**Use**

Detailed Design Considerations	YES	NO	N/A	Comment
34. Allowance is made for gloved hand in externally located access. (5.9.9.4.1)				
35. Equipment is capable of being removed, replaced, and repaired by personnel wearing personal and special purpose clothing and equipment, including NBC. (5.9.1.7)				
36. Openings provide access to fully clothed and equipped 95th percentile male hand and arm dimensions. (5.9.9.5)				
37. Openings provide appropriate depth of reach for fully clothed and equipped 5th percentile females. (5.9.9.5)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	ACCESSES, COVERS & CAPS
HF Considerations	Safety
Abbreviation	Safety

Detailed Design Considerations	YES	NO	N/A	Comment
38. Accesses are labeled with warning signs which identify hazards within and precautions needed. (5.9.9.3)				
39. Where a hazardous condition exists behind an access, access is equipped with an interlock that de-energizes the hazardous equipment when opened/removed. (5.9.9.5.1.5)				
40. Accesses over dangerous mechanical or electrical components have an internal light and a warning on door. (5.13.5.3)				
41. Edges and corners on covers and cases are rounded to prevent injury.				
42. Pressurized caps are captive.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

18. MEASURES

DESIGN CHECKLIST

Components	MEASURES
HF Considerations	Functionality
Abbreviation	Function

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N/A	Comment
1. Display precision and response is consistent with that of system. (5.1.1.3)				
2. Information is directly usable. (5.2.1.3.3)				
3. Scales on measures: a) Are linear. b) Start at 0. c) Use whole numbers. d) Have 2 pointers max. e) Numerals are oriented upright. (5.2.3.1.4/5)				
4. Information is limited to that necessary to take action. (5.2.1.3.1)				
5. Canteen cup is usable as standard or emergency measuring device for field use.				
6. Field items are non-corrosive and are easily cleaned or disposed of.				
7. For group use general formulas for computation are given.				
8. Item container can be used for measuring where possible.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	MEASURES
HF Considerations	Functionality (Cont.)
Abbreviation	Function

Detailed Design Considerations	YES	NO	N/A	Comment
9. Minimum number of measuring devices is used.				
10. Specified measuring amounts are consistent with measuring device.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	MEASURES
HF Considerations	Location, Clearance, Visibility
Abbreviation	Loc

Detailed Design Considerations	YES	NO	N/A	Comment
11. Display arrangement is consistent from one application to another. (5.2.1.4.10)				
12. Containers allow for full hand and finger clearance when using opening tool.				
13. Display viewing distance is 13 to 25 in. (330 to 635 mm). (5.2.1.4.11/12)				
14. Measuring marks and displays are located so they can be read to the required accuracy. (5.2.1.4.1)				
15. Reflections are minimized. (5.2.1.4.4)				
16. Measurement marks are raised.				
17. Measures are clearly detailed.				
18. Measuring marks on opaque containers are placed inside.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

19. REPLACEABLE UNITS

DESIGN CHECKLIST

Components	REPLACEABLE UNITS
HF Considerations	Functionality
Abbreviation	Function

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N/A	Comment
1. Blind screwdriver adjustments have mechanical guides. (5.9.3.2)				
2. Common hand tools are provided for field units. (5.9.12.2)				
3. Faulty equipment is easily detected and quickly removed/repaired using standard parts or modules. (5.9.1.6)				
4. Grasp areas are provided on carried units. (5.9.11.5.1)				
5. Guide pins, rollout racks, interlocks, drawers, hinges, or quick disconnects aid removal and replacement. (5.9.12.4/6/8)				
6. Item does not have to be disassembled to lubricate. (5.9.5.1)				
7. Item failure is indicated or alarmed. (5.9.17.1.2)				
8. Lamps are replaceable with power on. (5.2.2.1.16)				
9. Remote handling devices are compatible and have quick disconnects, captive fasteners, and feedback. (5.10.1.1/2/3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	REPLACEABLE UNITS
HF Considerations	Functionality (Cont.)
Abbreviation	Function

Detailed Design Considerations	YES	NO	N/A	Comment
10. Similarly shaped items with different functions are not interchangeable. (5.9.2.2)				
11. Similarly shaped items with different functions have standard orientation. (5.9.2.2)				
12. Units that are pulled out of item are mounted on rollout racks, slides, or hinges. (5.9.12.6)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	REPLACEABLE UNITS
HF Considerations	Location & Arrangement
Abbreviation	Loc

Detailed Design Considerations	YES	NO	N/A	Comment
13. All tire valves are accessible. (5.12.9.2.1)				
14. Fuses are easily accessible. (5.9.17.2.2)				
15. Parts are mounted on one plane, not stacked. (5.9.2.1)				
16. Replaceable units are readily accessible. (5.9.12.9/10)				
17. Replaceable units remain "open" without support and are well laid out. (5.9.12.9/10)				
18. Fill points and drains are reachable by 5th percentile personnel wearing restrictive or bulky clothing. (5.9.1.8)				
19. Vehicle drain valves, fuel/oil filters, distributors fuel injectors, fan belts, etc. are accessible for inspection/replacement. (5.12.9.1.1/2/3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	REPLACEABLE UNITS
HF Considerations	Clearance & Separation
Abbreviation	Clear

Detailed Design Considerations	YES	NO	N / A	Comment
20. Check points, test points, connectors, and labels are accessible during maintenance. (5.9.4.3)				
21. Enough clearance is provided to replace parts without contacting hazards. (5.9.4.3)				
22. Large parts do not prevent access to other parts. (5.9.4.2)				
23. Simple indicator lights have clearance for easy bulb replacement. (5.2.2.3.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	REPLACEABLE UNITS
HF Considerations	Visibility & Identification
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N/A	Comment
24. Battery terminals are marked "+"/"-". (5.12.9.1.4)				
25. Components are visible from maintenance position. (5.9.9.6)				
26. Fuses are labeled/rated. (5.9.17.2.3)				
27. Grasp areas are identified. (5.13.2.7)				
28. Labels are provided for hoist, jack, and lift points; center of gravity; "no-step"; and weight of item. (5.9.11.3.9)				
29. Lubrication points are labeled as to type and frequency. (5.9.5.2)				
30. Parts, components, circuits and assemblies are meaningfully labeled. (5.5.6.1.1)				
31. Reference scales are readily visible. (5.9.3.3)				
32. Replaceable items are coded/keyed. (5.9.12.5)				
33. Similarly shaped items with different functions are easily identified. (5.9.2.2)				
34. Maintenance points contrast with background.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	REPLACEABLE UNITS
HF Considerations	Safety
Abbreviation	Safety

Detailed Design Considerations	YES	NO	N/A	Comment
35. Delicate parts are protected. (5.9.2.3)				
36. Fuel service equipment has automatic shutoff device. (5.13.7.3.2)				
37. Positive and negative battery terminals are different sizes. (5.12.9.1.4)				
38. Hazards are conspicuously placarded. (5.13.2.1)				
39. Internal controls located near rotating parts, high voltages, or other hazards are shielded. (5.9.3.6)				
40. Sensitive adjustments are guarded and hand support is provided. (5.9.3.5)				
41. Stops are provided for rollout racks and the center of gravity does not shift to the extent that the console topples. (5.9.12.6/7)				
42. Units can be accessed without danger from heat, moving parts, electricity, chemicals, and/or radiation. (5.13.5.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

20. TEST ELEMENTS & TOOLS

DESIGN CHECKLIST

Components	TEST ELEMENTS & TOOLS
HF Considerations	Functionality
Abbreviation	Function

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N/A	Comment
1. Lamp test circuits are incorporated. (5.2.2.1.14)				
2. Calibration and adjustment controls with limited motion have mechanical stops to prevent damage. (5.9.3.4)				
3. Indication of equipment power failure is provided. (5.9.17.1.1)				
4. Display is provided to show equipment that is out-of-tolerance or has failed. (5.9.17.1.2)				
5. Positive indication of an open fuse is provided. (5.9.17.2.1)				
6. Electrical potentials over 300V are stepped down for test points. (5.13.7.1.7)				
7. Test points and built-in meters are used to isolate failed unit or module				
8. Tools are provided with rings or eyes compatible with quick release snaps or hooks on tool belts.				
9. External test points are of the jack terminal design; internal test points are of the stand-off terminal design.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	**TEST ELEMENTS & TOOLS**
HF Considerations	**Location & Arrangement, Size & Shape, Clearance**
Abbreviation	**Loc**

Detailed Design Considerations	YES	NO	N/A	Comment
10. Test points for adjustment are close to the controls or displays used. (5.9.15.1)				
11. Test equipment either fits the hand or has handle or hand support.				
12. For reaching test points limiting body dimensions are based on 5th percentile user. (5.6.1)				
13. Large parts are not mounted to deny access to smaller ones. (5.9.4.2)				
14. Sufficient space is provided for test equipment or tool use. (5.9.4.3)				
15. Access to unit maintained by one technician does not require removal of one maintained by another. (5.9.4.7)				
16. Cables terminating on control/display panels do not interfere with controls/displays. (5.9.13.4)				

YES = Adequate **NO = Inadequate** **N/A = Not Applicable**

DESIGN CHECKLIST

Components	TEST ELEMENTS & TOOLS
HF Considerations	Visibility & Identification
Abbreviation	Vis

Detailed Design Considerations	YES	NO	N / A	Comment
17. Mechanical guides are provided when a screwdriver adjustment must be made without visual access. (5.9.3.2)				
18. Test equipment adjustments, check points, cables, connectors, and/or labels are visible during maintenance. (5.9.4.3)				
19. Contacts, terminals, etc. over 500V are clearly labeled. (5.13.7.1.4)				
20. Test equipment has panel lighting.				
21. Test points are permanently labeled and color-coded.				
22. A simple check shows when equipment is out of calibration.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	TEST ELEMENTS & TOOLS
HF Considerations	Use Conditions
Abbreviation	Use

Detailed Design Considerations	YES	NO	N/A	Comment
23. Lamp replacement is possible with power on and from panel front. (5.2.2.1.15/16)				
24. Special tools required for adjustment are with equipment. (5.9.1.2)				
25. Knobs are preferred to screwdrivers for frequent adjustment. (5.9.3.1)				
26. Reference scale is provided for control adjustment. (5.9.3.3)				
27. Sensitive adjustment points have a handrest or armrest nearby if vibration is present during adjustment. (5.9.3.5)				
28. Sensitive adjustment points are guarded against accidental disturbance. (5.9.3.5)				
29. Test points are accessible. (5.9.4.3)				
30. Special tool use is minimized. (5.9.12.2)				
31. Items frequently removed for test are mounted on rollout racks, slides, or hinges. (5.9.12.6)				
32. Braces hold hinged assemblies in working position. (5.9.12.9)				
33. Cables are long enough to check unit in place. (5.9.13.3)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	TEST ELEMENTS & TOOLS
HF Considerations	Use Conditions (Cont.)
Abbreviation	Use

Detailed Design Considerations	YES	NO	N/A	Comment
34. Sufficient test points are provided to prevent removing subassemblies for testing. (5.9.15.2)				
35. Adequate storage is provided in portable test equipment case or lid to contain leads, probes, spares, manuals, or tools. (5.9.16.1)				
36. Quick-release removal is provided for optics. (5.11.3.18.3)				
37. Test points reflect the sequence for sequential testing.				
38. Stands or casters are provided for equipment exceeding 30 lb. (13.6 kg); wheels or hoists are provided for equipment exceeding 90 lb. (40.8 kg).				
39. Test equipment is not overly complex or difficult to use.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	TEST ELEMENTS & TOOLS
HF Considerations	Safety, Operating Procedures
Abbreviation	Safety

Detailed Design Considerations	YES	NO	N/A	Comment
40. Internal controls located near hazards are shielded and labeled. (5.9.3.6)				
41. Rollout racks do not shift the center of gravity to the extent that the console topples. (5.9.12.6)				
42. Tools and/or test leads used near high voltages are insulated. (5.13.7.1.1)				
43. Contacts and terminals are shielded with suitable protective measures to prevent accidental contact. (5.13.7.1.4)				
44. Electrical hand-held tools have 3-wire power with ground or are double insulated. (5.13.7.1.6)				
45. Exposed surfaces of electrical hand-held tools are nonconducting or grounded. (5.13.7.1.6)				
46. Operating instructions for portable test equipment are affixed to unit, lid, or compartment. (5.9.16.2)				
47. Calibration reminder is included with test instructions. (5.9.16.2)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

21. CLOTHING & PERSONAL EQUIPMENT

DESIGN CHECKLIST

Components	GENERAL CLOTHING & PERSONAL EQUIPMENT
HF Considerations	Size & Shape
Abbreviation	Size

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N/A	Comment
1. Clothing, headwear, handwear, footwear, sleeping gear, and equipment is sized for personnel within the 5th to 95th percentile per FIGURES 23 to 28 in MIL-STD-1472D. (5.6.3.5)				
2. Essential and critical clothing, etc. is sized for personnel within the 1st to 99th percentile per FIGURES 23 to 28 in MIL-STD-1472D. (5.6.3.5)				
3. The size and shape of the article of clothing, handwear, sleeping gear, combat hardware, and load carrying devices allows for use by 90% of the user population under the following conditions: a) Tasks to be performed by the wearer. b) The position of the body during the performance of tasks. c) Mobility/flexibility requirements. d) Critical dimensions imposed by obstacles, projections, etc. e) Critical dimensions imposed by protective clothing, equipment, package, lines, padding, etc. (5.6.1)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	GENERAL CLOTHING & PERSONAL EQUIPMENT
HF Considerations	Size & Shape (Cont.)
Abbreviation	Size

Detailed Design Considerations	YES	NO	N/A	Comment
4. Ponchos are fitted only for length, but must be large enough to cover a fully equipped man.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	GENERAL CLOTHING & PERSONAL EQUIPMENT
HF Considerations	Direction & Force, Operating Procedures
Abbreviation	Dir

Detailed Design Considerations	YES	NO	N/A	Comment
5. Individual portions of equipment do not weigh more than 35 lb. (16 kg). (5.11.1 1.1)				
6. The total load carried by an individual, including clothing, weapons and equipment for close combat operations does not exceed 30% of body weight. (5.11.1.2.2)				
7. The total load carried by an individual, including clothing, weapons and equipment does not exceed 45% of body weight. (5.11.1.2.2)				
8. For 5th percentile personnel, total load for close combat operations does not exceed 36 lb (16.3 kg). (5.11.1.2.2)				
9. For 5th percentile personnel, total load for marching does not exceed 54 lb (24.5 kg). (5.11.1.2.2)				
10. Special use instructions are permanently attached. (5.5.4.5)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	BODYWEAR
HF Considerations	Functionality, Use Conditions
Abbreviation	Body W

Detailed Design Considerations	YES	NO	N/A	Comment
11. Ponchos and large protective garments cover packs, weapons. (5.6.1)				
12. Protective clothing fits snugly at openings. (5.6.1)				
13. Fasteners open and close silently.				
14. If snagging or catching will jeopardize wearer, then velcro, snaps, or other quick-release fasteners are used.				
15. Items are of a dull finish and are non-reflecting.				
16. Clothing worn with full combat gear does not degrade performance in any combat task. (5.6.1)				
17. Protective clothing is adaptable to various camouflage requirements. (5.6.1)				
18. Protective clothing used in cold weather remains supple and does not stiffen.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	HEADWEAR
HF Considerations	Functionality, Size & Shape
Abbreviation	Head W

Detailed Design Considerations	YES	NO	N/A	Comment
19. Headgear allows adequate vision, eating, or drinking when in use. (5.6.1)				
20. Headgear allows use of binoculars or telephones or aiming/firing of weapons without removal and loosening. (5.6.1)				
21. Inside of face plates is fog resistant or is easily opened and cleaned.				
22. Adjustments accommodate the full range of head sizes. (5.6.3.4)				
23. Combat headgear fits securely to prevent tilting or knocking askew during strenuous action.				
24. Protective headgear is large enough to fit over helmet or thin enough to fit under helmet, whichever is the case.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	**HEADWEAR**
HF Considerations	**Safety**
Abbreviation	**Head W**

Detailed Design Considerations	YES	NO	N/A	Comment
25. Headgear is compatible with hearing protection.				
26. Facepiates and eyepieces are shatterproof.				
27. Headgear which involves electrical equipment is non-conductive.				
28. Safety helmets are shatterproof.				

YES = Adequate **NO = Inadequate** **N/A = Not Applicable**

DESIGN CHECKLIST

Components	HANDWEAR
HF Considerations	Functionality, Size & Shape, Use Conditions
Abbreviation	Hand W

Detailed Design Considerations	YES	NO	N/A	Comment
29. Handwear is flexible and supple for performance of combat tasks. (5.6.1)				
30. In the event handwear is not flexible, etc., alternative protection is provided. (5.6.1)				
31. Waterproofed items have ventilation capability. (5.6.1)				
32. Wrist buckles are adjustable with mitten or glove on. (5.6.4)				
33. Gloves, mittens, etc., are large enough so that fingers are not cramped and flexibility of hand is not impaired. (5.6.3.5)				
34. Cold weather handwear fits snugly at wrist.				
35. Anti-contact gloves provide protection and allow manipulation. (5.6.1)				
36. Arctic mitten liners allow detailed work when required without exposing hand or wrist. (5.6.1)				
37. Mitten for weapon use allows single finger use but not arctic exposure of finger. (5.6.1)				
38. Outside of handwear, shells blend with standard camouflage.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	FOOTWEAR
HF Considerations	Use Conditions, Safety
Abbreviation	Foot W

Detailed Design Considerations	YES	NO	N/A	Comment
39. Shoes and boots are compatible with foot controls. (5.6.1)				
40. Footwear size allows for expansion due to heat or load carrying. 5.6.1)				
41. Combat footwear design allows user to climb and perform tasks with minimum of slipping, etc. (5.6.1)				
42. Boots are compatible with skis and snowshoes. (5.6.1)				
43. Soles of boots and shoes are slip-resistant. (5.6.1)				
44. Shoes and boots used around heavy equipment have rigid "safety" toe.				
45. Electrically heated socks cannot shock wearer, especially when wet.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	PERSONAL EQUIPMENT
HF Considerations	Functionality, Use Conditions
Abbreviation	Pers

Detailed Design Considerations	YES	NO	N/A	Comment
46. Air mattresses are provided with easy-to-use patch kit.				
47. Bag liners are provided for ease of cleaning.				
48. Bags are easily turned inside out for airing and cleaning.				
49. Bags have self-contained ties and wraps.				
50. Snapped bags have quick release capability.				
51. Zippered bags have both internal and external zipper tags.				
52. Sleeping bags are designed to eliminate any possibility of accidental suffocation.				
53. Sleeping gear is not excessively bulky when rolled or packed.				
54. Zippers and fasteners operate quietly.				
55. Inside and outside of bags, liners, and covers are dark, dull colors.				
56. Sleeping bags used in snow have white exterior.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	COMBAT HARDWARE
HF Considerations	Functionality
Abbreviation	Combat H

Detailed Design Considerations	YES	NO	N/A	Comment
57. Adjustments can be accomplished while item is worn. (5.6.3.5)				
58. Backpacks do not: a) Produce unbalanced loads or shoulder strain. b) Interfere with walking, climbing, shoulder movement, or body temperature regulation. (5.11.1.2.4)				
59. In the case of two-soldier carrying, stretcher-type handles and shoulder supports are provided. (5.11.1.1.4)				
60. Individual items weigh as little as possible. (5.11.1.2.1)				
61. Maximum use is made of standard load-carrying devices. (5.11.1.1.5)				
62. Carrying cases are weather proof.				
63. Gas mask and goggles are usable with helmet.				
64. Material of load-carrying devices is mildew, rot, and rust proofed.				
65. Metal components are rustproof and corrosion-resistant.				
66. Pack-carried items fold or collapse to take up minimum space.				
67. Replacement of expendable components is done without tools.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	COMBAT HARDWARE
HF Considerations	Location & Arrangement, Size & Shape
Abbreviation	Combat H

Detailed Design Considerations	YES	NO	N/A	Comment
68. Backpacking aids are designed to distribute the load over as many muscle groups as possible. (5.11.1.2.4)				
69. Backpacking aids place the load's center of gravity as close to the carrier's spine as possible. (5.11.1.2.4)				
70. Load carriers have balanced loadings. (5.11.1.2.4)				
71. A single-size device can accommodate smallest user in tropic clothing to the largest user in cold weather clothing. (5.6.1)				
72. Arctic clothing fits 5th-95th percentile personnel. (5.6.4)				
73. Equipment handles for mittened, gloved or bare hand use conforms to the size requirements of FIGURE 48 in MIL-STD-1472D. (5.9.11.5.5)				
74. Gas masks, goggles, and life preservers are adjustable on personnel and fit snugly. (5.6.3.4)				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	COMBAT HARDWARE
HF Considerations	Direction & Force
Abbreviation	Combat H

Detailed Design Considerations	YES	NO	N/A	Comment
75. Individual portions of equipment may weigh up to 35 lb. (15 kg) if load ~~is~~ balanced and well distributed of if it is not necessary to maintain pace of infantry. (5.11.1.1.1)				
76. Load-carrying minimizes application of pressure/compression to the chest and armpits to transmit weight to the ground through bone. (5.11.1.2.4)				
77. Marching load is 54 lb. (24.5 kg) maximum. (5.11.1.2.2)				
78. One-person backpacked loads over 44 lb. (20 kg) are provided with lifting aids for assistance from second soldier. (5.11.1.2.3)				
79. Rifleman's fighting load is 40 lb. (18 kg); other than fighting, 45 lb. (20 kg).				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	COMBAT HARDWARE
HF Considerations	Visibility, Use Conditions
Abbreviation	Combat H

Detailed Design Considerations	YES	NO	N/A	Comment
80. Eye and face coverings afford maximum vision and hearing to wearer.				
81. Survival items are brightly colored.				
82. Combat hardware items of sufficient size and weight to interfere with balance have proper placement and type of attachment.				
83. For rough terrain and climbing, heavy load-carrying items are anchored at or near the bottom.				
84. Loose straps, chains, and other noise-producing elements are covered and anchored to reduce noise.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	COMBAT HARDWARE
HF Considerations	Safety
Abbreviation	Combat H

Detailed Design Considerations	YES	NO	N/A	Comment
85. Heavy load items have quick release capability for doffing in an emergency. (5.11.1)				
86. Load permits freedom of movement and has no sharp edges or projections. (5.11.1.1.3)				
87. Loads have minimum projections to prevent personnel injury or entanglement in undergrowth. (5.11.1.2.5)				
88. Sharp edges are adequately covered during portage. (5.11.1.2.5)				
89. The carrying and wearing of emergency items does not interfere with required combat task performance. (5.11.1.1.3)				
90. Emergency items are accessible at all times.				
91. Faceplates and optics are shatterproof.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

22. STRUCTURAL COMPONENTS

DESIGN CHECKLIST

Components	STRUCTURAL COMPONENTS
HF Considerations	Functionality, Size & Shape
Abbreviation	Function

Test Title	
Test Project No.	Date

Detailed Design Considerations	YES	NO	N/A	Comment
1. Connection, lifting, and test points are easily reached before and after mating with other components. (5.9.1.3)				
2. For mechanical or power lift devices, hoist and lift points are provided and labeled. (5.9.11.3.9)				
3. Operating, mechanical, and/or electrical components are tested prior to assembly.				
4. Components are sized and shaped to be handled by arctic mitts. (5.9.1.7)				
5. Component shape is such that its connection method is obvious.				
6. Component size and shape are determined by environment, (e.g., jungle, slope, swamp, etc.).				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	STRUCTURAL COMPONENTS
HF Considerations	Clearance & Separation
Abbreviation	Clear

Detailed Design Considerations	YES	NO	N/A	Comment
7. Clearance is such that components can be removed/replaced quickly and easily.				
8. Components are well-spaced both during and after erection so that the hand and tools can be easily inserted and efficiently utilized.				
9. Components requiring replacement, adjustment, and calibration are accessible during erection.				

YES = Adequate NO = Inadequate N/A = Not Applicable

DESIGN CHECKLIST

Components	**STRUCTURAL COMPONENTS**
HF Considerations	**Visibility & Identification**
Abbreviation	**Vis**

Detailed Design Considerations	YES	NO	N / A	Comment
10. Blind attachments are avoided whenever possible. (5.4.1.7)				
11. Connection/test points are labeled. (5.9.15.3)				
12. Each assembly, component, and part is labeled or identified. (5.5.6.1.1)				
13. Sequence of assembly is clearly defined and accompanied by illustrations/diagrams. (5.5.1.1)				
14. Minimum assembly visibility requirements are: <u>Coarse</u> 30 ft-c. (325 lux). <u>Medium</u> 50 ft-c. (540 lux). <u>Fine</u> 75 ft-c. (810 lux). <u>Precise</u> 200 ft-c. (2,155 lux).				
15. Preservatives, paint, or grease applied to components cannot hide cracks or breaks in structural members.				

YES = Adequate **NO = Inadequate** **N/A = Not Applicable**

DESIGN CHECKLIST

Components	STRUCTURAL COMPONENTS
HF Considerations	Safety
Abbreviation	Safety

Detailed Design Considerations	YES	NO	N/A	Comment
16. Exposed edges and corners are rounded 0.03 in. (0.75 mm). (5.13.5.4)				
17. Exposed edges and corners that may present a safety hazard are rounded 0.5 in. (13 mm). (5.13.5.4)				
18. Non-sparking tools are used in explosive atmosphere. (5.13.7.1.7)				
19. Sensitive and delicate components are protected against dust, rain, or mud during assembly and erection. (5.9.2.3)				
20. Sharp edges are covered/sheathed for safe handling.				
21. If heights are involved, hooks and eyes are provided for attaching safety belts/lines.				
22. Structural members used for climbing conform to criteria for steps, ladders, and platforms.				

YES = Adequate NO = Inadequate N/A = Not Applicable

APPENDIX C

HEDGE FIGURES

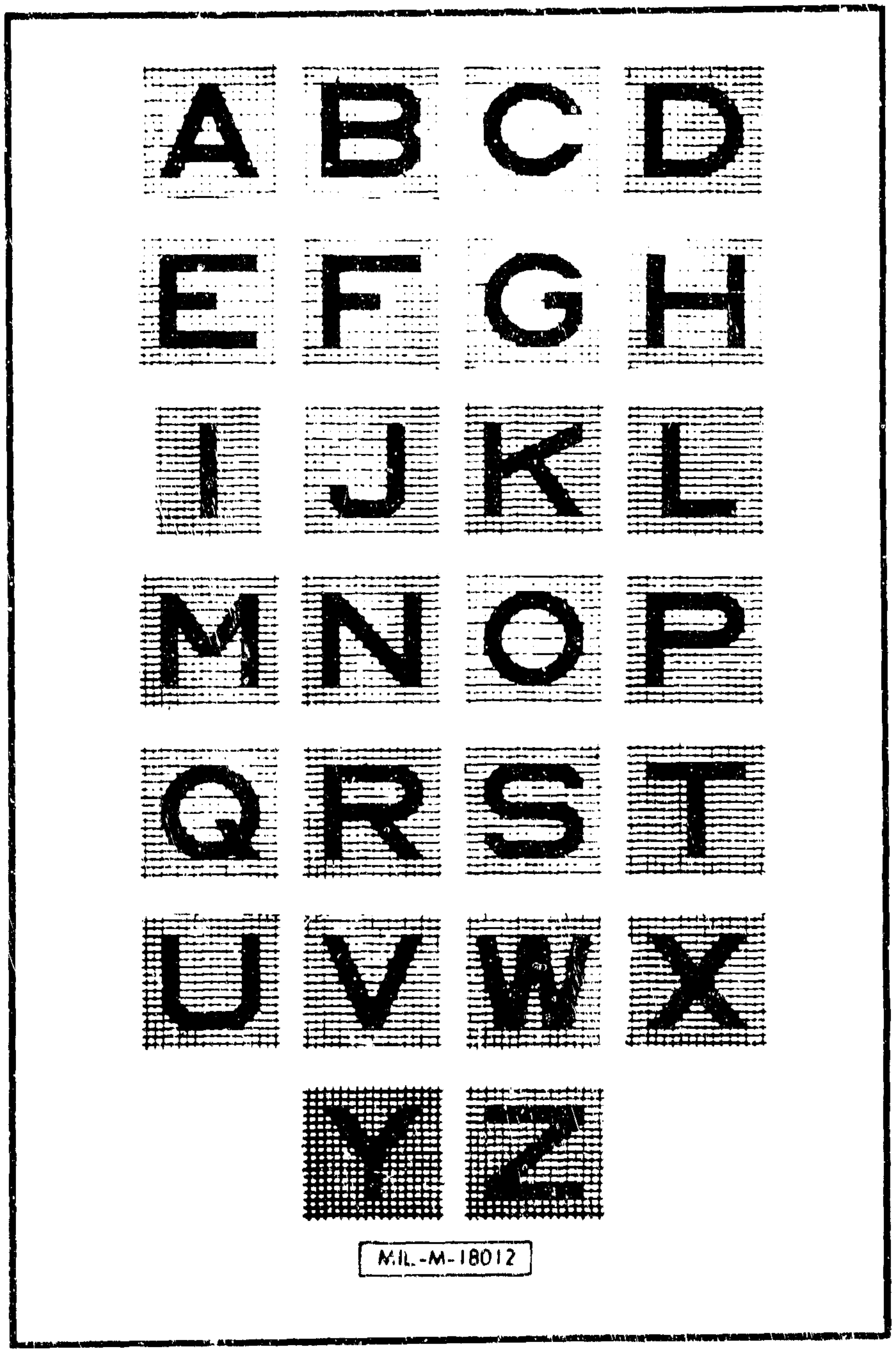

Figure C-1. Preferred Letter Format

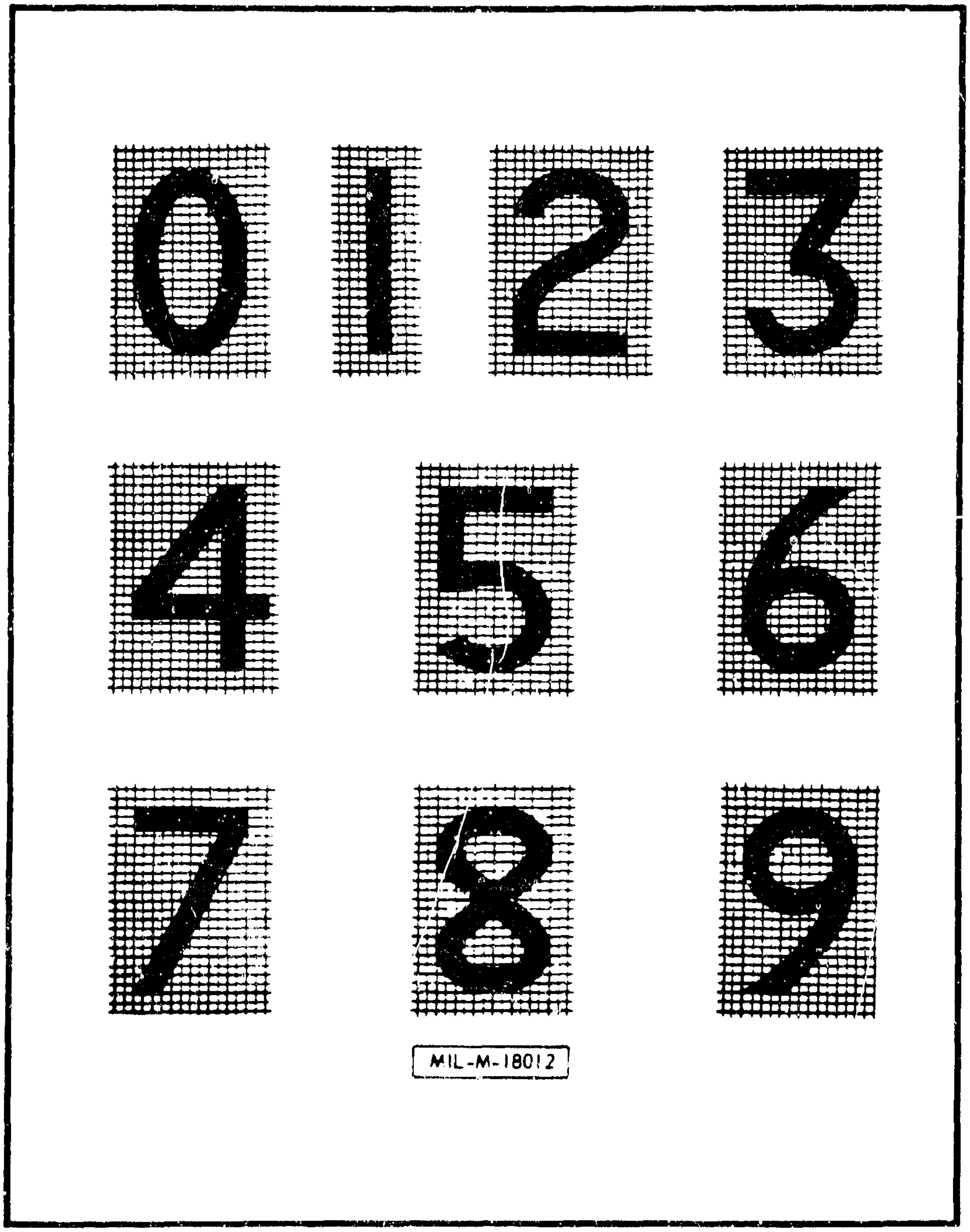

Figure C-2. Preferred Numerical Format

FONTS FOR ENGRAVING

LETTERS

ABCDEFGHIJKLMNOPQRSTUVWXYZ& .,:;'

GORTON EXTENDED

ABCDEFGHIJKLMNOPQRSTUVWXYZ& .,:;'"×-°

abcdefghijklmnopqrstuvwxyz&

GORTON NORMAL

ABCDEFGHIJKLMNOPQRSTUVWXYZ& .,:;'"

GORTON CONDENSED

NUMBERS

1234567890

GORTON EXTENDED

1 2 3 4 5 6 7 8 9 0

GORTON MODERNE

Figure C-3. Other Acceptable Fonts

FONTS FOR PRINTING

LETTERS

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz .,:;-?!'"–()[]•$&
AIRPORT SEMIBOLD

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
a b c d e f g h i j k l m n o p q r s t u v w x y z : ; ' " " , .
FUTURA DEMIBOLD

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz;:'"",.
VOGUE MEDIUM

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
a b c d e f g h i j k l m n o p q r s t u v w x y z : ; " " , .
LINING GOTHIC No 66

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz .,:;-?!·'$&
ALTERNATE GOTHIC No 3

NUMBERS

123456789
FUTURA MEDIUM

123456789
FUTURA TEMPO BOLD

MIL-M-18012

Figure C-3. Other Acceptable Fonts (Cont.)

Airborne Noise Category	Center frequencies of standard octave bands, c.p.s.									SIL value
	31	63	125	250	500	1000	2000	4000	8000	
A	[illegible]	[illegible]	105	100	SIL value requirement			85	85	64
B	91	84	79	76	73	[illegible]	[illegible]	69	68	--
C	[illegible]	78	72	66	65	62	[illegible]	58	57	--
D	[illegible]	[illegible]	[illegible]	100	90	85	[illegible]	[illegible]	85	--
E	[illegible]	[illegible]	[illegible]	100	SIL value requirement			[illegible]	85	[illegible]
F	[illegible]	[illegible]	[illegible]	100	SIL value requirement			[illegible]	85	[illegible]

Airborne Noise Categories

Category A. Spaces other than Category E spaces where intelligible speech communication is necessary.

Category B. Spaces where comfort of personnel in their quarters is normally considered to be an important factor.

Category C. Spaces where it is essential to maintain especially quiet conditions.

Category D. Spaces or areas where a higher noise level is expected and where deafness avoidance is a greater consideration than intelligible speech communication.

Category E. High noise level areas where intelligible speech communication is necessary.

Category F. Topside operating stations or weather decks where intelligible speech communication is necessary.

Speech Interference Level (SIL)

Measure of the effect of airborne background noise on intelligible speech communication. Numerically, it is the arithmetical average of the sound pressure level in decibels in the octave bands with center frequencies of 500, 1000, and 2000 c.p.s.

[illegible]

Figure C-4. Airborne Noise Levels for Ship Compartments (in Decibels)

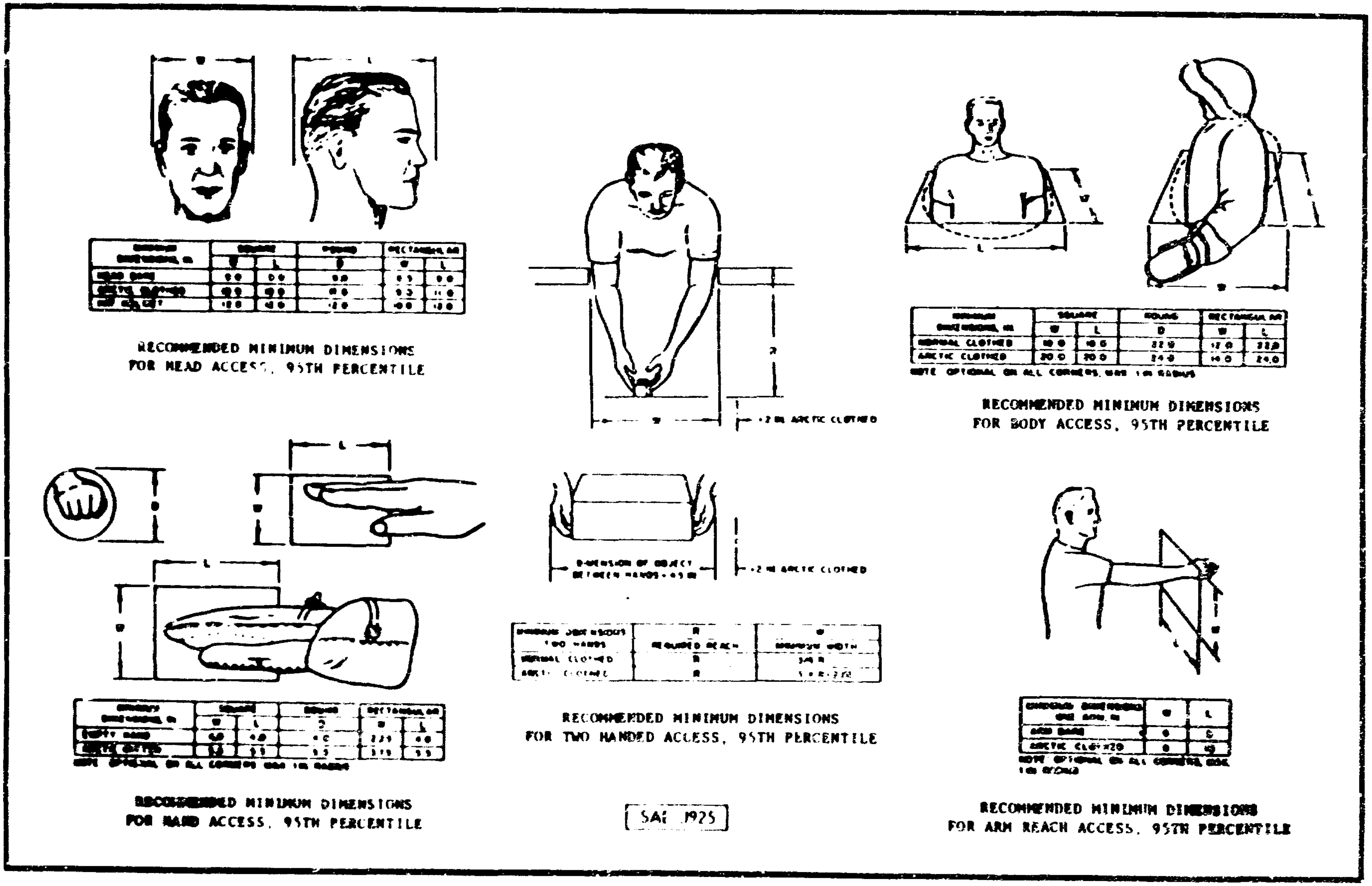

Figure C-5. Minimum Access Dimensions for Constructuction and Industrial Machinery